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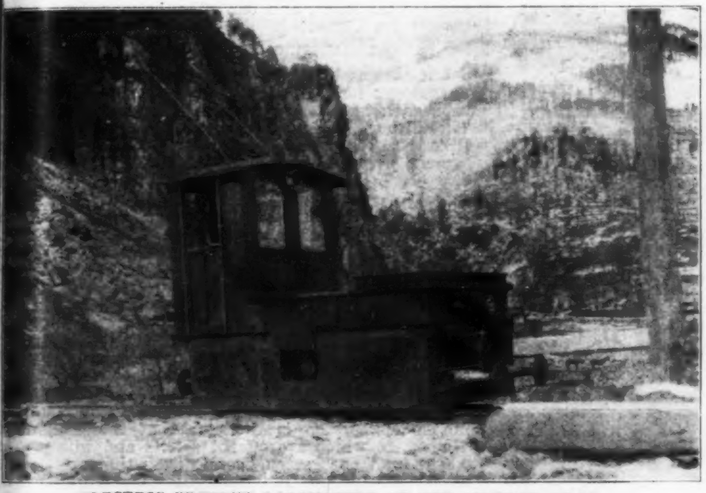
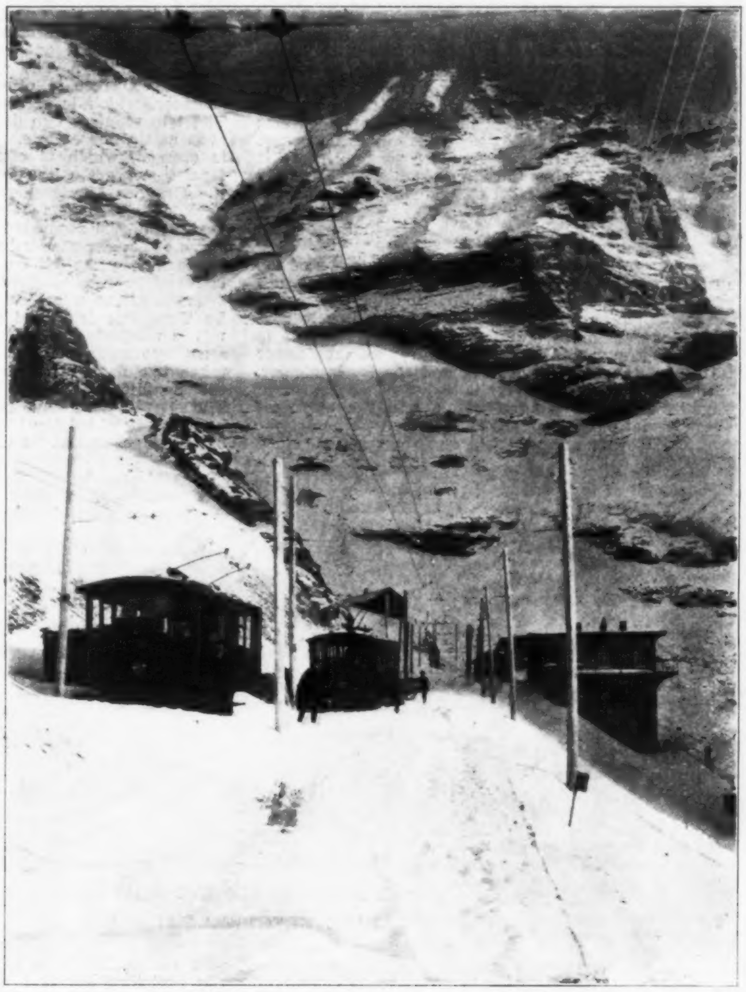
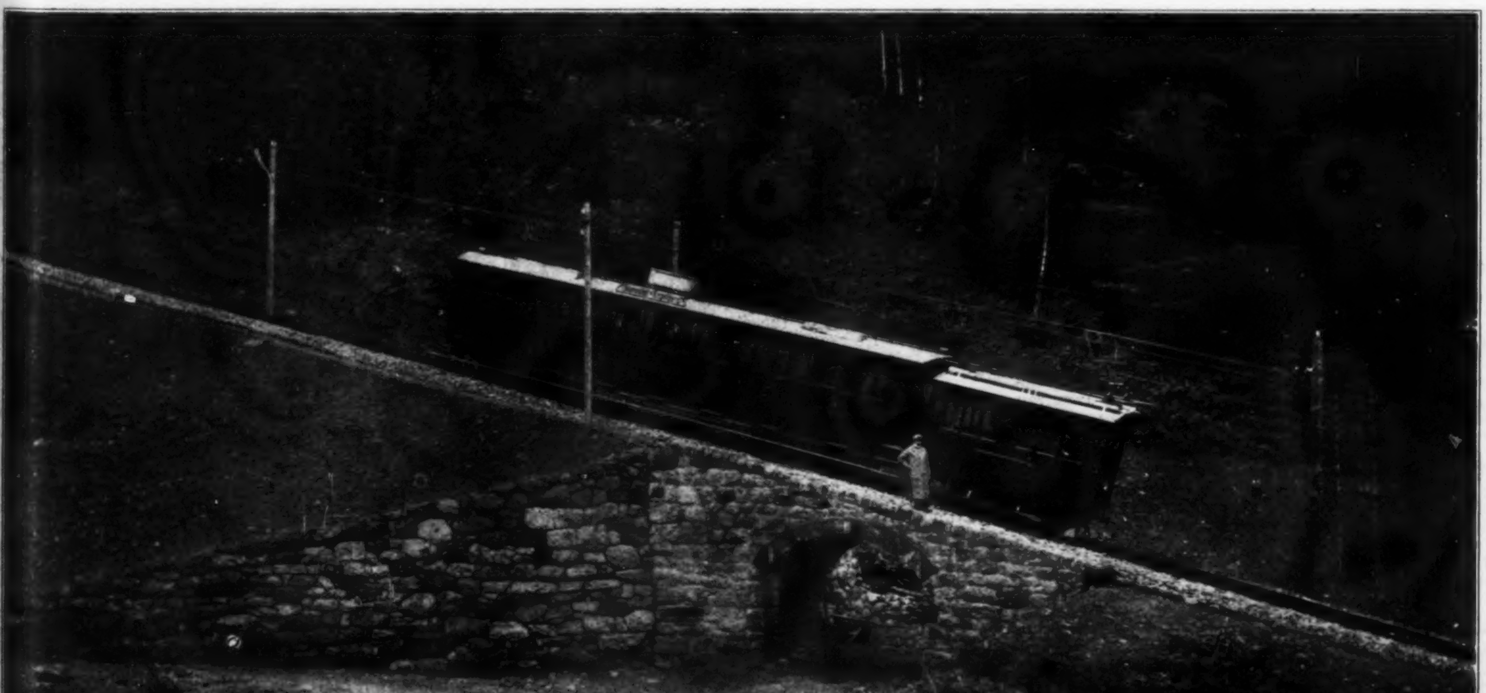
ENTRANCE TO THE ROTHSTOCK TUNNEL.



ELECTRIC FREIGHT LOCOMOTIVE OF THE SIMPLON ROAD.



"EIGERGLETSCHER"—A STATION ON THE JUNGFRAU RAILWAY.



STANZSTAD-ENGELBERG POLYPHASE ELECTRIC RAILWAY.

ALPINE ELECTRIC RAILWAYS.

THE SERVICE OF ELECTRICITY IN CLIMBING THE ALPS.*

By Frank C. Perkins.

In many large cities in this country and in Europe where the population is greatly crowded, the summer is one of the most trying seasons of the year. The heat and lack of air in the evenings are keenly felt, and are almost overpowering. The pavements of the city streets, and the high buildings, absorb a vast amount of the sun's heat, radiating it at night, and, taken together with the dust-laden atmosphere, make sleep impossible. During the heated summer season all who are able endeavor to seek cool and quiet spots for rest and recreation. One of the most satisfactory places to spend the trying summer days is in the high altitudes among the snow-capped mountains.

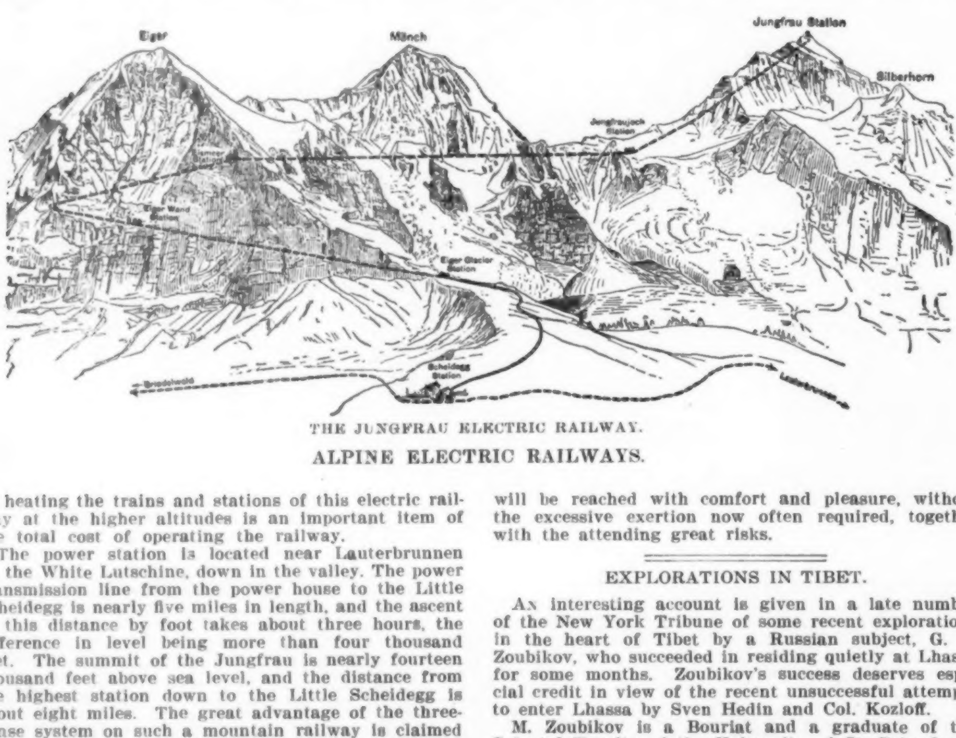
Electric power is now utilized for climbing the great mountain ranges in America as well as in Europe. The mountain railway, which is a masterpiece of electrical engineering, climbs to the summit of the Jungfrau, along the passes of Mont Blanc, Gornergrat, and other heights of the Alps. The electric railway to the summit of the Jungfrau passes through tunnels and climbs grades exceeding 20 feet rise in every 100 feet traveled. The stations along the electric railway from Eiger Wand are built within the rock, and are fitted with restaurants and sleeping accommodations for those passengers who wish to break the journey. From the Eiger Wand and Eismeer stations there is no egress onto the mountain, and tourists are only able to enjoy the view from the balcony, but from the Jungfraujuch station it is possible to go out onto the Jungfraufirn and sledge over the perpetual snowfield to the Aletsch glacier.

The Jungfrau electric mountain railway is one of the most interesting applications of three-phase alternating-current transmission and distribution yet made. The water power is made use of in the valley to generate a current of several thousand volts, and this is transmitted by means of overhead wires to transformer stations at the Little Scheidegg and the Eiger glacier. At these stations the current is transformed from high pressure to a few hundred volts, and the electrical energy is not only employed for traction purposes, but also for lighting and heating. The energy expended in heating the trains and stations of this electric railway at the higher altitudes is an important item of the total cost of operating the railway.

The power station is located near Lauterbrunnen on the White Lutschine, down in the valley. The power transmission line from the power house to the Little Scheidegg is nearly five miles in length, and the ascent of this distance by foot takes about three hours, the difference in level being more than four thousand feet. The summit of the Jungfrau is nearly fourteen thousand feet above sea level, and the distance from the highest station down to the Little Scheidegg is about eight miles. The great advantage of the three-phase system on such a mountain railway is claimed to be the simple automatic braking action of the induction motors. The locomotive is fitted with three absolutely independent brakes. The first is an automatic one, electrically controlled. By means of a centrifugal governor, when a speed greater than a certain maximum is reached, the current is automatically switched off from the motors, and at the same time a band-brake is actuated. This brake can also be applied by the guard in the passenger car. The second brake is a hand brake, which applies bronze shoes to a wheel on the driving axle. The third is an emergency brake, which grips the rack, or geared rail, and can be applied by either the driver or the guard. The Jungfrau passenger cars can hardly be called trailers, as they are pushed, and not pulled, by the locomotive. They are built for forty passengers each, and are lighted by fifteen incandescent lamps. The view from these cars as they climb to the summit of the Jungfrau, is magnificent, and the passage through the tunnels and along the steep mountain sides is most thrilling.

An electric railway has been installed in the Alps at Mont Blanc, and makes this trip possible to many who otherwise would have to forego this pleasure. It takes but a single night to reach the foot of Mont Blanc, the Giant of the Alps, from Paris, where the heat is almost unbearable on many summer evenings. This magnificent mountain is first seen on arriving at Sallanches, and the scenes on the way to Chamonix are most charming. The electric railway from the Fayet climbs up the Arve path, crosses the torrent by the Saint Marie viaduct, a marvel in stone, nearly two hundred feet high, and sweeps by the edge of the Taconnaz and Bossons glacier. The flower-clothed meadows, wild valleys, and pastures ringing with cattle-bells, as well as the cottages adjoining the waterfall, are a succession of enchanting scenes. Above all, and over all, is the ever-present view of the Giant of the Alps, Mont Blanc, with its glittering peaks, glaciers, and domes grouped about it. Chamonix is a beautiful little Alpine town of several thousand inhabitants, wonderfully situated, and well supplied with the best guides to be found. The Chamonix Railway is supplied with power from the Servoz hydro-electric works. Many tourists enjoy the mountains without wishing to risk the fatigue of an ascent. Chamonix is a remarkable center from which trips are taken by the electric railway to various stations, which are charming starting points for easy expeditions. Brevent is a peak about 8,000 feet high, from which the view of Mont Blanc and its glaciers is unsurpassed.

Balmat made the ascent of Mont Blanc for the first time in 1786, and this was considered a most remarkable feat. The next year he made scientific and meteorological observations with De Saussure and a number of guides. Since this feat was accomplished by Balmat, numerous tourists have made the ascent, including a number of ladies. It is, however, exceedingly difficult and rather long, requiring considerable physical endurance, and should not be undertaken lightly. The climb to an altitude of more than 15,000 feet is often accompanied by mountain sickness, which is somewhat similar to sea sickness. The trip requires two days, the first of which usually ends at Grands Mulets. From here the Petit Plateau is crossed, which is often swept by the avalanches from the *seracs* of the Dome. Then the snow slant of the Grandes Montees is reached, which leads to the Grande Plateau at a height of 12,792 feet. This is a vast hemicycle separated from the Calotte by the ice abyss of the Grande Crebasse. The ridge of the Bosses is reached by the Col du Dome, and the Vallot Refuge is found in proximity to the observatory built by Joseph Vallot at a height of 14,317 feet. The rock of La Tournette is passed at last, and finally the summit is reached, 15,776 feet in height, where the Janssen Observatory is found built upon the snow. It thus takes two days to climb Mont Blanc, although could the summit be reached by a straight line only nine kilometers would have to be covered. Electric power has already aided the traveler greatly in the climbing of the Alps, and at no distant date the highest peaks will be reached with comfort and pleasure, without the excessive exertion now often required, together with the attending great risks.



THE JUNGFRAU ELECTRIC RAILWAY.

ALPINE ELECTRIC RAILWAYS.

* Specially prepared for the Scientific American Supplement.

EXPLORATIONS IN TIBET.

An interesting account is given in a late number of the New York Tribune of some recent explorations in the heart of Tibet by a Russian subject, G. Z. Zoubikov, who succeeded in residing quietly at Lhassa for some months. Zoubikov's success deserves especial credit in view of the recent unsuccessful attempts to enter Lhassa by Sven Hedin and Col. Kozloff.

M. Zoubikov is a Bouriat and a graduate of the Oriental Faculty of the University of St. Petersburg. As a born Buddhist and familiar from childhood with Tibetan, he found no difficulty in passing for a llama. He brought back a great number of photographs and other illustrations of the life of the country, and his book, which will soon be published, will contain much information hitherto unobtainable.

M. Zoubikov made an extended report of his journey at a meeting of the Geographical Society a few days ago. He was immediately awarded the Przhevalsky prize, which is conferred in honor of the first Russian Tibet explorer.

The frontiers of Tibet, which were closed to European travelers after the French explorers Huc and Gabet were expelled from Lhassa, in 1846, have not been absolutely shut against a certain portion of Russian subjects, namely, the Buddhistic Bouriats of the Baikal region. The Bouriats are talented people, and the same value attaches to M. Zoubikov's observations as would be the case were he a European. His stay lasted over a year.

In the summer of 1900 M. Zoubikov entered Tibet from the north as a member of a caravan of seventy pilgrims, including many llamas. He approached central Tibet by the Boumza Mountain, where Przhevalsky was turned back in 1870. The road led through a treeless country with snow-topped mountains extending east and west in parallel chains. The people in this region were few and nomadic. An agricultural community was found within only sixty or seventy miles of Lhassa.

CLIMATE AND POPULATION.

The climate was found to be harsh and dry. Snow falls occasionally from December to March; rain from May to August. April, September, October and November are dry. The medium annual temperature was found to be 42, 67, and 50 deg. F. for morning, noon, and night respectively. The data for December w… 17, 34, and 27 deg., and for July 60, 77, and 65 deg.

The population, which has at times been estimated at 33,000,000, is probably about one-tenth of this number. It is decreasing through disease, particularly smallpox, and on account of the large number of celibate priests.

The sons of Chinese soldiers and merchants temporarily resident in Tibet are counted Chinese, the daughters Tibetans. Other foreign residents are Indians from Cashmere and Mongolians and Tibetans from Nepul, the latter being skilled artisans, architects, sculptors, and jewelers. The Cashmere Mahometans are traders. They usually convert their Tibetan wives.

Almost all the land in central Tibet belongs to the Dalai Llama. Only high officials in Lhassa have hereditary homes. The Tibetan houses are of brick and stone, and have chimneys only in the kitchen. The other rooms have holes to let the smoke escape, and are cheerlessly cold. Dried dung is the principal fuel.

The common folks wear white, the wealthy r… officials yellow, and soldiers blue clothing of homespun. Jewels are worn in great abundance by the women. Barley meal, soup, the raw flesh of the y… and of sheep, butter, sour milk, and vegetables are main items of the diet. Wheat spirits sell for a c… a bottle. Men smoke tobacco and the priests take snuff.

PEOPLE RELIGIOUS AND IMMORAL.

The people of central Tibet are passionately attached to their religious observances, which are purely formal. Prayers are regarded as of magic potency and figure in all ordinary and extraordinary affairs of life. Medicine is in small popular favor. Morals are primitive, and marriage ties are loose. Both polygamy and polyandry are common.

Agriculture and cattle raising are the principal employments. Wheat, barley, peas and beans, cattle, sheep, yaks, horses, asses, and mules are the main products. Yaks and asses are used as pack animals. Labor is cheap, men being paid two or three cents a day, while women usually serve for their food and clothing. Even a llama receives only ten cents for a whole day's prayers. Sheepskins, cattle, yak tails, statues, books, and yellow llama caps are exported. The yak tails serve as horse tails in the outfit of Turkish pachas. English and Indian cottons and woolens and copper and enamel utensils are introduced from India, and tea, silks, cottons, horses, and asses from China.

EXHAUSTING METHOD OF WORSHIP.

Lhassa was built in the seventh century. It has a picturesque location on the southern slope of a mountain, with luxurious gardens on the west and south. The Uithcu River passes to the south of the city. Dikes and canals have been constructed as protection against overflows. A fine, broad street around the city serves for religious processions and penitential exercises. Penitents go the length of this street falling to the ground every five or six feet, so that in a day they prostrate themselves about 3,000 times. The city is small, having at most only 10,000 regular inhabitants. It is, however, an important trade center. The native traders are all women.

The Temple of Buddha, in the center of the city is about 140 feet square. It is three stories high and has three gilded Chinese roofs. It shelters a gigantic bronze statue of Buddha, which has a hammered gold and jeweled headdress. A sacrificial fire, fed with melted butter, burns before the statue. Other statues and relics are kept in other chambers of the same temple, among which is the statue of the Goddess of Women, to which are offered spirits and wheat. The wheat is at once eaten by mice. In the same temple are also rooms for the Dalai Llama and his council.

The residence of the Dalia Llama is about a mile away from Lhassa, on Mt. Bodala. It was built in the seventh century. Near by is the old castle Hodson-Bodala, which is 1,400 feet long and nine stories high. Here are the treasury, the mint, the schools of theology and medicine, quarters for 1.200 officials and 500 monks, and a prison. As many as 1,000 priests take part in religious processions to this mountain.

M. Zoubikov also minutely describes various monasteries and temples, including three near Lhassa, where 15,000 monks are mainly engaged in learned pursuits. At one of these—Brabun—nearly 6,000 boys, young men, and even gray-bearded patriarchs are studying theology, the total number of resident monks being 8,000.

SELECTION OF THE LLAMA.

Tibetan Buddhism, brought from India in the seventh century, struggled against the native Shamanism until the ninth century, when a compromise was agreed upon. According to the current teaching there are many spirits which are continually reincarnated in men. The Dalai Llama is the living Buddha. Another defender of the faith is the spirit Choidshen, whose power is manifested through pious ascetics who spend their lives in contemplation.

Since the fifteenth century all power, civil and spiritual, has been nominally in the hands of the Dalai Llama, but China maintains a Manchu resident and an army. In order to avoid strife in selecting a Dalai Llama, the electoral council places three strips of paper with the names of three boys in an urn, and the Manchu resident removes one with a small staff. The new Dalai Llama's education is intrusted to a college of learned men. Until his twenty-second year the government is in the hands of a regent appointed by the Emperor of China. The present Dalai Llama is twenty-seven years old. He is the fifth since 1806, one of the regents having continued in authority for an unusually long time, owing to three children selected to be Llamas having died before attaining majority.

The Dalai Llama's Council, in whose hands is the actual power, embraces four so-called "Galons," appointed by the Emperor of China. The administration is in the hands of a closed aristocracy, and bribery and corruption are nearly universal. Among the common penalties are drowning, torture, flogging, banishment, and fines. The Tibetan army of four thousand men is poorly disciplined, and is armed with bows and old fashioned guns. Robbery flourishes.

THE INTERNATIONAL STUDY OF THE SEA.*

The publications mentioned below are the first reports of the International Council for the Study of the Sea, which was constituted by the meeting of representatives of the maritime powers of northern Europe at Christiania in 1901, and now has its seat at Copenhagen. The bulletins deal with what has come to be known as hydrographic work carried out on the quarterly cruises, in which special ships of each of the participating States take part. The word hydrography is not, however, used in the sense made familiar by the hydrographic offices of the various admiralties; it means, if we may borrow for a moment the terminology of chemistry, scarcely more than inorganic oceanography. We say scarcely more, for in these bulletins it does include the study of the distribution of plankton, but for this purpose plankton are treated rather as current-floats than as organisms.

It will be remembered that the International Council was formally constituted at a conference held at Copenhagen in July, 1902, and that no time was lost in getting to work is plain from the fact that the first number of the Bulletin deals with a series of cruises in August, 1902, the second with a similar series in November or December, 1902, and the third with February, 1903. These cruises have since been continued quarterly, and we understand that they are now more complete, and the results obtained more readily comparable than was possible when the collaboration was only beginning. Viewed from the standpoint of scientific efficiency, the work of the Council is hampered by the very short term for which the various governments have granted the necessary funds and the stringent conditions as to endeavoring to obtain practical results directly beneficial to fisheries which have been insisted on in some cases. But there is reason to hope that these very difficulties will act as a spur.

The bulletins are mere records of observations, they contain a minimum of explanatory letterpress, and no discussion at all. It might be found desirable to print a little more information, for instance, as to the constitution of the International Council and its administrative bureau, the address of the office and a brief statement of the objects for which the organization has been brought into existence. The salient features of the maps of the physical conditions of the surface water might also be expressed in words, and the stations at which observations were made ought to be indicated on the map of each cruise by dots. We are inclined to lay stress on this point, as without some indication of the kind the maps are difficult to interpret, and the scale is not large enough to permit the figures of each observation to appear.

The August and November cruises were carried out in the Baltic by Finland, Sweden, Denmark, and Germany, in the North Sea by Germany and Scotland, and in the North Atlantic and Arctic Sea by Norway and Russia. To these there were added in February observations in the North Sea by Holland, and in the English Channel by England; England and Scotland being separately represented, mainly on account of the different nature of the fishery problems in their respective areas. It may be noted that these bulletins do not touch on the fishery observations, nor on the biological work (the determination of plankton excepted), which occupy the whole time of the various national staffs between the quarterly cruises. They do not refer either to the work of the Central Laboratory at Christiania.

The importance of the bulletin lies in the fact that it gives particulars of the temperature and salinity at a great number of points from latitude 45 deg. to 75 deg. N., observed nearly simultaneously and with comparable instruments of the highest precision, the temperature being determined by means of the Pettersson-Nansen insulated water-bottle and thermometers graduated to the fifth or even the tenth of a degree centigrade, the salinity by estimation of chlorine.

Both for August and November the central part of the North Sea appears to have been left without observations, but this gap was partly filled up in February when the system of quarterly cruises was more complete, and a number of supplementary observations by trading steamers had been added. The indications in the published maps are of a slight freshening along the British coast, a belt of maximum salinity running parallel to the coast toward the middle of the North Sea, increasing in salinity rapidly to the northwest between Scotland and Faeroe, and to the southwest toward the English Channel. The whole of the eastern half of the North Sea shows a rapid freshening toward a stream issuing from the Baltic close along the west coast of Jutland.

Where the temperature observations were sufficiently close and regular to permit of isotherms being drawn, they present a remarkable relation to the isohalines. In August the one isotherm shown is that of 12 deg. C., which runs from Aberdeen to Lindesnaes, cutting the isohalines at right angles. In the November map, however, the isohalines and isotherms exhibit a most striking parallelism, so that the circulation of the water in that month could be studied with equal facility by considering either the temperature or the salinity. Thus at the southern end of the North Sea the isotherm of 13.5 deg. C. coincides with the isohaline of 35.25 per mille, and the isotherm of 13 deg. C. with the isohaline of 35.00 per mille. At the mouth of the Baltic the two sets of lines though parallel do not correspond symmetrically, while on the northwest side of the Baltic stream 10 deg. lies close to 34‰ on the east side it lies close to 32‰. Still the axis of the Baltic stream is the same whether it is drawn from the one set of lines or the other.

The February map shows the isotherms parallel with the isohalines in the south and east of the North Sea, but cutting them nearly at right angles in the more open waters of the north and west. The difference in the broad action of the Atlantic in the wide part of the sea and the river-like action of the Channel in the southern part is brought out in a most interesting manner.

It is very important to secure a great extension of surface observations, and this, we believe, is now being done by many shipmasters who make regular observations on the various trade routes across the North Sea. Even if these fall short of the high accuracy attained by the special scientific vessels, they will prove invaluable in fixing the general run of the isotherms during the quarterly cruises, and of following the changes which take place between them.

We consider that these bulletins are satisfactory and full of the promise of large results. The too scanty letterpress is printed in parallel columns in German and English; the title only is in French.—Nature.

* Conseil permanent international pour l'Exploration de la Mer. Bulletin des Résultats acquis pendant les courses périodiques. Publié par le Bureau du Conseil avec l'assistance de M. Knudsen, Chargé du Service Hydrographique. Année 1902-1903. Nos. 1, 2 et 3. (Copenhague: A. F. Høst et Fils, 1903.)

HOW THE EXPENSIVE FUR OF THE SEA OTTER IS SECURED.

The season for killing the most expensive fur-producing animal—the sea otter—the fur of which is manufactured into robes for potentates and princes of the Old World and capitalists of this and other countries, closed on October 1, having begun on May 1. According to reports received at the Treasury Department and the Department of Commerce and Labor, the latter of which exerts official supervision over the set-otter industry in Alaska, so far as the preservation and regulation of hunting and killing of the animal are concerned, the sea otter is becoming scarcer every year, and threatens in a short time to enter the list of "animals of the extinct class."

It is not generally known that the only species of sea otter is found on the northern Asiatic and northwestern American coast, and it is remarkable that the extent of territory in the United States where these animals are taken is so extremely limited, being only from Damon's Point, at the northern entrance to Gray's Harbor, up the coast to Point Greenville, in the State of Washington, a distance of about twenty-four miles. The animal is a descendant of an extinct race, and really belongs to a past age. He is shy and hard to locate, employing clever means to avoid the enemy. Sea otters are most frequently found in masses of what is known to the sailors as "bladder kelp," and sometimes "sea otter cabbage." This kelp, like the animal that inhabits it, is a relic of bygone ages. It is a giant seaweed, found only in the North Pacific Ocean, among whose huge fronds the sea otters make their homes.

Nereocystics is the scientific name of the weed, and its formation has often attracted the attention of scientists. The stems are sometimes several hundred feet long, slender, but of enormous strength, and they terminate in large club-shaped bulbs, from which spring tufts of fronds of gigantic size. The stems and fronds become so thickly massed together that they form floating islands, which are the home of the sea otters.

Unlike that of the seal, the fur of the sea otter requires no plucking of hair or coloring—in fact, the most valuable skins are those which are speckled through with a silver tipped fur, the addition of this hair adding 25 to 50 per cent to the price of the skin. The otter hunters build for themselves derricks about forty feet high, by taking three slim poles or pieces of timber, each about forty feet in length. They bolt them securely together at one end for the top, and spread them about twenty-five feet apart at the bottom, giving them the appearance of a huge tripod. These are set on the ocean beach, about midway between high and low tides, the feet of the poles being imbedded in the sand from two to three feet. The structure is then thoroughly braced, and a ladder built to the top by nailing pieces at convenient distances crosswise on the inland portion of the tripod. About eighteen inches below the top of the tripod cross timbers are secured to the legs, and upon these cross timbers a floor from four to five feet square is laid, and on the oceanward and two adjacent sides walls are built up from three to four feet in height. On the land side a door is constructed to allow easy ingress and egress to and from this "crow's nest." On the top of the tripod, which extends about eighteen inches above the floor, a seat is constructed, and around the inside of the wall a row of shelving is placed. At low tide, when the wind is propitious, the hunter hies himself to his crow's nest, armed with a good pair of glasses, a rifle, a luncheon, and a little something to keep him warm, and for six long hours he scans the line of the ocean just outside of the breakers, where he expects his game to appear. When the tide first begins to flood, his range is about six hundred yards, but as it runs in the range is shortened to two hundred or three hundred yards. Even at these latter distances it requires close calculation to know just how to shoot to overcome the rise and fall of the ocean swell and the effect of the wind upon the bullets. It is said that not one out of one hundred shots of the best marksmen is effective. When the tide is full the derrick stands in the midst of the breakers, and a land-lubber is apt to feel a little squeamish looking down from the dizzy heights on the rolling waters below. The shooting is generally done on a flood tide, so that the animal, when killed, will wash ashore, and even then it is sometimes three or four days after one is killed before it is beached. Each hunter marks his bullets with a mark known to the other hunters, and when an otter is found on the beach the first duty of the finder is to look for the bullet and ascertain who is the rightful owner, for this sign is respected among the hunters as sacredly as marks and brands are among stockmen. When an otter comes ashore with no bullet in him, as is frequently the case, the bullet having gone clear through the body, and no notice having been given, it is regarded as a "slick ear," in stockmen's parlance, and belongs to the finder. Sometimes an otter, on receiving a death shot, sinks; but the hunter generally knows when he has hit his mark. By observing the water with his glasses he can discern, even at the great distance at which they shoot, the coloring of the water from the blood of the animal, and if he does not come ashore on that tide notice is at once given to the other hunters, who are then on the alert to find him. It is the general opinion among hunters that beachcombers, in the shape of stealthy Indians, get away with many an otter killed by white hunters. The Indians hunt the otter in canoes, going out and coming in through the surf. Sometimes they go fifteen or twenty miles to sea and stay out several days. But when they hunt along within a mile or two of the shore, then there is blood on the face of the moon, and the white hunter waxeth wroth, for the Indian scares away his game.

The Treasury Department regulations governing sea-otter hunting and vessels employed in transporting sea-otter hunting parties within the Territorial waters of Alaska provide that no person shall be allowed to kill sea otter within the limits of Alaska Territory or its waters from or by the use of any boat or vessel other than the ordinary two hatch, skin-covered bidarka or the open Yakutat canoe, and they also provide that only sailing vessels and bidarkas and open Yakutat canoes may be employed in transporting sea-otter hunting parties to and from the hunting grounds. The government prohibits the use of nets for the capture of this most expensive fur-bearing animal, and also interdicts the killing or taking of sea-otter pups, and gives instructions each year to officers of the United States who may be stationed in the localities where sea otter are taken to take all proper measures to enforce the penalties of the law. Foreign vessels of every description are forbidden to hunt sea otter within the Territorial waters of the United States.

When taken the otter is skinned whole, as it were, by cutting across the haunches and stripping the skin down the body and over the head. The skin is then turned, the fur in, and a board shoved through it. It is then tightened by driving a wedge-shaped piece down on one side between the board and the skin, and another contrariwise on the other. All the grease is then carefully removed, and the skin is dried and laid away, ready for the market. An average skin is about five feet long by twelve inches wide, double, or, when cut, twenty-four inches wide, and in the hunter's hands is valued at from $125 to $150, but these prices leave a handsome margin to the fur men who handle them. In Russia an overcoat made from these same otter skins brings from $1,000 to $2,000, while in China even more is sometimes paid. The game is getting to be so scarce that four skins a season is considered as doing well by any hunter. In fact, some pass the season without taking any. The hunters have a rule among themselves, which is strictly observed, that only one derrick is allowed within a range of about half a mile.

Fur trade papers complain that the more expensive fur bearing animals are growing scarcer every year, and advocate legislative measures to prevent their entire extermination. In a recent report to the State Department on the Siberian fur industry, Consul-General Holloway, at St. Petersburg, said that leading experts claim that unless Russia, the United States, England, Canada, and Japan agree to put a stop to pelagic sealing, "seals will disappear from the market." The leading market for Siberian furs is Irbit, one thousand miles east of Moscow and one hundred and fifty miles east of the Ural Mountains, and Nijni Novogorod, where annual fairs are held. The fair at Irbit is held in February each year, and that at Nijni Novgorod in July and August. The former is much the larger, the supply of better pelts consisting of bear, glutton, lynx, elk, reindeer, stag, musk ox, sea otter, fox, sable, marten, mink, ermine, polecat, squirrel, Alpine wolf, and blue, silver, and red fox, and one or two kinds of wildcat indigenous to Kamchatka. The Siberian black hare has become very scarce, as well as blue fox, which brings about $50 a fell. Speaking of the condition of the market, Mr. Holloway said that the supply was not equal to that of former years. "The number of buyers from all the leading capitals of Europe and America increased and prices were higher, which is attributed in part to the fact that the world has adopted the American fashion of wearing furs outside instead of as linings, which requires better skins. Although a Russian company enjoys the monopoly of catching Alaska seals, they are sold in London and none are to be found in the Russian market.

"Previous to September, 1902, Russian squirrel fells were used only as linings for women's shubas, but the demand at the Nijni Novgorod fair during that year and this was so great that the price increased and the undressed skins sell at from 10 to 30 cents each. It requires from 100 to 250 to make a jacket, 60 to 150 for a cap, 20 to 40 for a boa, and 5 to 10 for a muff. Pale squirrel tails are sold at $2.63 a pood (36.112 pounds), and dark squirrel tails are sold at $3.13 a pood. White foxes are held at $6 each. Undressed sable skins sell from $15 to $200 each, and it requires from 50 to 100 to make a jacket, 30 to 60 for a cap, 2 to 12 for a boa, and 2 to 8 for a muff.

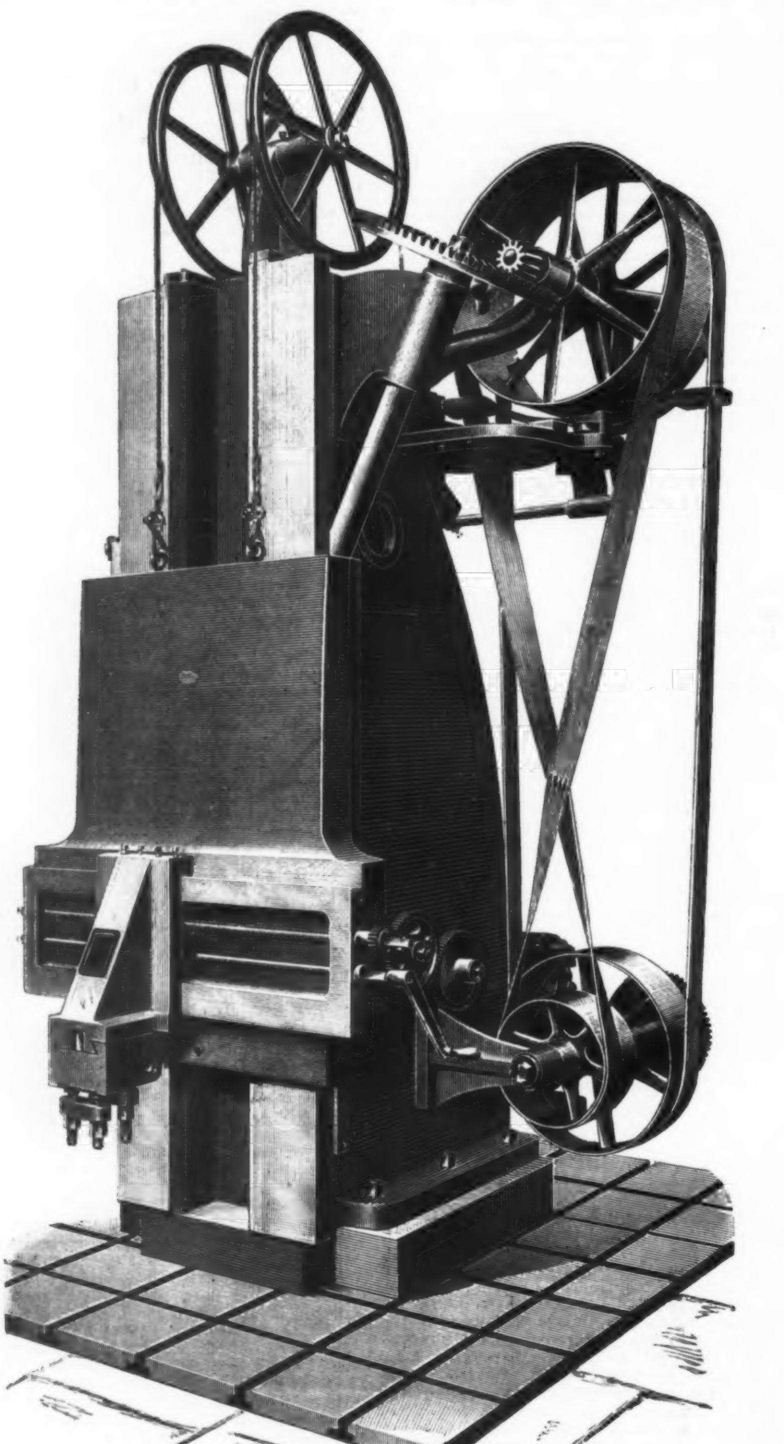
"Sable and ermine remain the favorite furs with those who can afford to purchase the best. Local merchants at Irkutsk purchase a considerable quantity of furs from hunters and trappers, as do all merchants throughout Siberia, which, if not shipped direct to Moscow and St. Petersburg, find their way to the annual fair at Irbit, where the leading fur houses of the world are represented by buyers."

Commercial Agent Greener, at Vladivostok, recently informed the State Department that "the fur trade in this province is in a critical condition. Prices have fallen very much and first-class furs are hard to get. Buyers complain that through the action of some English traders a few years ago in paying extravagant prices to the natives for furs—furs ultimately sold by the buyers at a loss—the regular prices were greatly inflated."—New York Tribune.

The new ship channel known as the Ambrose Channel, which is the main entrance to New York harbor, will necessitate the excavation of 42,000,000 cubic yards of earth. The channel will be 40 feet deep, 2,000 feet wide, and seven miles long. At the lower end of the channel a cut is being made, 35 feet deep, 1,000 feet wide, and one and a half miles long. Contracts are to be let for two new dredges to be used in completing the main channel, and eight months hence, when these new dredges are in commission, the dredging output will be twice what it now is. It is estimated that the work will cost $24,000,000.

FORTY-EIGHT-INCH STROKE SLOTTING MACHINE.

The question whether it is better economy to take the work to the machine, or the machine to the work, has entered on a new phase since electric driving has become so widespread. It is now so easy to drive tools in any position that, in many instances, it is better to shift them than the work. When the latter is heavy, it may be operated upon by several light tools simultaneously, it being far easier to set them than the object itself. Illustrated below is a slotting machine of 48-inch stroke, which can be clamped on a cast-iron baseplate, and can be moved about to bring it up to various parts of the work. It is driven by an electric motor at the back, the tool being operated by a rack and a spiral pinion in the well-known way.



FORTY-EIGHT-INCH STROKE SLOTTING MACHINE.

The cross-feed on the saddle is 30 inches, and the in-and-out adjustment 4 inches. The machine is constructed by the Newton Machine-Tool Works, Philadelphia.—Engineering.

PARSONS TURBINES IN STEAMSHIP SERVICE.

It is interesting to note the extent to which Parsons motors are now employed for steamship propulsion. Their first appearance in this field was in connection with torpedo craft, when the motors became unfortunately associated with the loss of the "Cobra" and the "Viper." That these disasters were, however, not due in any way to the fault of the motors themselves, but to the frailness of the craft, is shown by the fact that further craft of this kind have been built equipped with similar motors. Two Clyde pleasure steamers have been running with them for some time with results satisfactory in every way; while the new steamer, "Queen," put on the Channel service by the South-eastern & Chatham Railway, has, by all accounts, more than fulfilled expectations in regard both to comfort and seaworthiness, as well as speed. The Newhaven-Dieppe steamer "Brighton" attained a speed of 21 knots on trial. The Midland Railway Company have also ordered two turbine steamers—one from Messrs. Denny, of Dumbarton, and one from Messrs. Vickers, Sons & Maxim, Barrow-in-Furness—for their new services between Heysham and Belfast and Heysham and the Isle of Man; while it has just been announced that turbine steamers are to be employed in the mail and passenger service between Larne and Stranraer. In addition, the Union Steamship Company, of New Zealand, are having built at Dumbarton a large sea-going turbine steamer which will mark yet another advance in the development of the new motor; while the United States government propose to build an experimental gunboat of 5,000 tons to be equipped with turbines.

The question of employing turbines for the Cunarders has assumed a new phase by the appointment, at the suggestion of Lord Inverclyde, the chairman of the Cunard Company, of a special commission, consisting of joint representatives of the company and the Admiralty, as well as of Lloyd's and other independent shipbuilders, to investigate the whole subject. As their representative the Admiralty have named Admiral Oram, the deputy engineer-in-chief of the navy, and have also agreed to Lieutenant-Engineer Wood acting as secretary, in which capacity he served on the recent boiler committee. Mr. J. Bain, the general manager of the Cunard Company, will be a member, and Mr. J. T. Milton, the engineering surveyor of Lloyd's Registry, will represent that interest. Outside shipbuilders will be represented by Mr. H. Brock, of Denny's firm, who has been associated with the trials of the turbine-propelled merchant boats; Mr. Andrew Laing, of the Wallsend Engineering Works, and Mr. T. Bell, the engineering manager of the Clydebank works of Messrs. Brown. The list of names, it will be recognized, is a very representative one, and should, by the aid of trials which it is proposed to conduct, do a good deal to determine the latent possibilities of the steam turbine for the propulsion of steamships of large size, and especially in regard to the question of steam consumption, in which there is, we believe, considerable difference of opinion, arising largely from the fact that the turbine cannot be tested with an indicator like an ordinary reciprocating engine.—Mechanical Engineer.

TO FIND THE CAPACITY AND HORSE POWER OF PUMPS.

Among the many formulæ for finding the capacity of double-acting pumps as well as for determining the horse power requisite to a certain given quantity of work, the following, taken from the Vienna Metallarbeiter, is perhaps the simplest. The volume of water which a double-acting pump will deliver per second is theoretically equal to the cubic contents of the space the plunger passes through in a second of time, and will be obtained by multiplying the area of the plunger face or cross section by the speed of the same. The actual volume of water will of course be somewhat less, because the valves do not fall quickly enough to prevent a slight recession of the water; for this reason, it will be noted that the valves are adjusted with a very short lift and large cross-section. However, the relative percentage of the effective discharge to the theoretical is from 0.8 to 0.9, in new pumps even as high as 0.95, and in cases where extra large air chambers are provided, practically the whole intake is discharged at each stroke.

Naturally enough, single-acting pumps deliver only about half as much as double ones. Since now the area of the cross-section of the plunger agrees with the quantity of water to be raised, then the formula $Q \times G \times 0.9$ would express the volume for a double pump, and $\frac{Q \times G \times 0.9}{2}$ would signify the same for a single one, where $Q =$ area of cross-section of plunger, $G =$ speed of same, and 0.9 the mean percentage of effective discharge. I. Example: Given the diameter of a plunger 5 dm. and its speed 10 dm., find its capacity per second. From the well-known area formula $\frac{D^2 \times 3.14}{4}$, by substituting 5 for D we have $\frac{5^2 \times 3.14}{4} = 19.62$ dm.; now by substituting this for Q, we get $19.62 \times 10 = 196.2 \times 0.9 = 176.58$ dm. or liters of water for a double pump. The delivery of a single pump would be only half as much, or 88.29 liters.

II. Example: Given the speed of a plunger equal to 10 dm. and the volume of water to be lifted per second equal to 100 liters, find area of cross-section of plunger or pump-bore. The formula will then read:

$$10 \text{ dm.} \times Q \times 0.9 = 100\ l$$

$$Q = \frac{100}{10 \text{ dm.} \times 0.9} = \frac{100}{9} = 11.11 \text{ dm.}$$

from which $d = 376$ mm. for a double pump.

$$Q = \frac{100}{4.5} = 22.22 \text{ dm. and } d = 752 \text{ for single pump.}$$

Now a horse power indicates the amount of work required to lift 75 second-kilogrammeters, which is 75 kilogrammes one meter in one second. One liter of water weighs just one kilogramme.

To lift so many liters of water 75 meters a second, or so many times 75 liters of water 1 meter in a second, will comprise the horse power of a pump without regard to the friction, which is usually put down at about 25 per cent or one-quarter of the required work. Let the volume of water in liters per second be represented by L, the height in meters by H, then $\frac{L \times H}{75}$ + 25 per cent (one-quarter) will be equal to the power required, that is horse power.

III. Example: A pump must lift 360 liters 12 meters per second. How much power will be required? $360 \times 12 = 4320$ kg. $\frac{4320}{60}$ per second $= 72$ kg. Substitute in above formula these values, and we get $\frac{72}{75} = 0.96 + \frac{1}{4} = 1.20$ horse power for the pump.

TANGENTIAL WATER-WHEEL EFFICIENCIES.

At a recent meeting of the Pacific Coast Electric Transmission Association, George J. Henry, Jr., read a paper on "Tangential Water-Wheel Efficiencies." The conclusions which he has reached are the result of an elaborate series of experiments carried out in a special laboratory since 1899, with a view to determining scientifically and practically the relative advantages of different bucket shapes. To obtain the best efficiencies, it is necessary to have the proper pipe line, gate valves, nozzles, water-wheels and buckets, wheel gates, wheel pit, and tailrace, and all of these must be properly designed for the particular conditions under which they are to operate; and all will vary with the head or pressure, the quantity of water, and the revolutions which the wheel is to make. Many a water-wheel bucket has been overworked for years and then charged with losses that occur because of its being improperly worn, due to this overwork. Again, buckets are frequently charged up with all kinds of losses, which are really due to something for which the bucket is not responsible. Pressure or wheel diameter, or speed on a given wheel can not be varied radically without materially altering the efficiency. The various losses occurring at the bucket are due to the discharge velocity with which the water leaves the bucket, air and surface friction inside the bucket, imprisoned water in the bucket, variation in the stream form, producing erratic conditions of impact, the loss occasioned by the stream being displaced by the entering bucket, and eddy currents in the buckets.

To correct these losses, the following methods are suggested: The water should move in a curved path on the bucket surface and turn through an angle of as

nearly 180 degrees as possible. If the water moves in a smooth curved path and the stream form is retained, spreading out gradually with a fine fan-like discharge, and the least number of buckets used, then the air and surface friction will be a minimum. The imprisoned water will cause little loss if the bucket surfaces are smooth and so shaped that the water will leave the wheel freely. Displacement of the stream can be avoided by a proper shape of the cutting edge and dividing knife.

The above losses and considerations for their prevention are all of such a nature—so entirely interdependent—that their quantitative value can not be predetermined, except in a general way. In designing a water-wheel, it is certain that the exercise of the most careful judgment is necessary in laying out the surfaces.

The author then describes results of tests on a large number of different shapes and styles of buckets.

Mr. Henry's interesting paper will be shortly published in full in these columns, together with many illustrations.

NEW SUBTERRANEAN CONTACT FOR ELECTRIC TRAMWAYS.

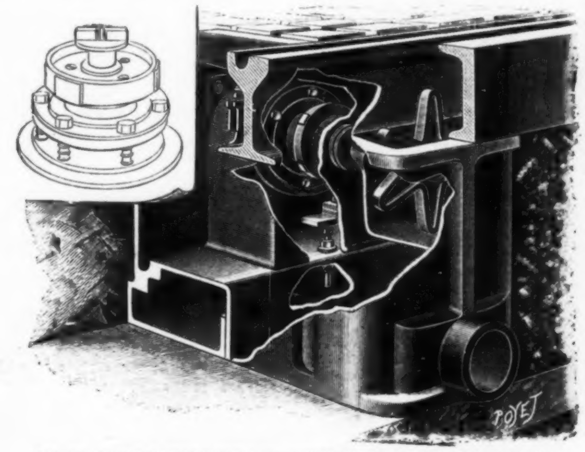
The opposition made by certain cities to the establishment of overhead conductors has given rise to the invention of a number of arrangements that assure the distribution of the current to the electric cars by a contact made at the level of the street or underground, and arranged in a special conduit. We shall not recall the inconveniences, at least the pecuniary ones, of such combinations. Our new contemporary, Traction and Transmission, has recently described a system called the Kingsland surface contact, in which an endeavor has been made to avoid the most obvious inconveniences of surface contacts, properly so called, and also those of deep conduits, which cost so much to install.

In all the systems of surface contact hitherto devised, the entrance of the current into the contacts is controlled electrically; and this may certainly have its advantages. As may be seen from the accompanying figure, alongside of the channeled rail, and parallel with it, there is a slot formed by the rail itself and a vertical U-iron, both of which latter are about 18 feet in length. This slot terminates in a box, which is provided laterally with a block of metal, forming a contact and containing all the mechanism necessary for sending the current into such contact, or, on the contrary, for interrupting it.

The street car is provided with a bar which runs normally in the slot, and which, when it reaches one of the boxes, strikes a wheel provided with six teeth and causes it to turn by a sixth of a revolution. This star wheel is supported on the right-hand side of the box by a bracket and shaft connected through an Oldham coupling with a commutator opposite a special tight box arranged opposite the star wheel. This commutator is provided with three segments, established at 120 degrees from one another. Moreover, two brushes, one of them connected with the line feeder and the other with the contact, rub against it. When these brushes are in contact with the insulated portion of the commutator, the contact remains dead, and no current enters it; but, when the car arrives, and, through the bar, turns the star wheel by a sixth of a revolution, the commutator, turned by the same movement, immediately establishes a communication between the feeder and the contact, thus making it possible for the current to enter the motor of the car. As the car is provided in the rear with another bar, which strikes and revolves the star wheel in its turn, the commutator is again revolved, thus breaking the circuit as the car leaves the section, and cutting the current off from the contact that supplies the collecting shoe.

In order to prevent the production of sparks, the contacts are so arranged that the current shall never be broken at one of them before the contact shoe has reached the one following. Moreover, the commutator is so constructed that it shall be able to withstand the production of sparks with impunity. Furthermore, particular measures have been taken to prevent undue stresses, and a revolution of more than one-sixth under the action of the bar arranged beneath the car. In the commutator box, and on the opposite side of the latter, with respect to the star wheel, there is arranged a ratchet-screw device upon the same shaft with the commutator and star wheel. The shaft carries a screw with interrupted threads, somewhat analogous to that of the breech of guns, but in which the threads are not prolonged on each side of the channel that cuts the pitch of the screw. Consequently, when the commutator is set in rotation, its shaft screws itself into an inoperative position, but only by a sixth of a revolution, because it meets with the following threads, which are not in the prolongation of those upon which it has screwed itself. It is therefore arrested at the moment desired; and then a backward motion takes place in the direction of the channeling, and, by the pressure of a spring, everything is put in condition for another passage of a car, and for a new sixth of a revolution of the star wheel. Let us add that the system of right and left-hand screw threads permits of the use of one and the same contact box for the running of cars in either direction, since the commutator is then set in rotation in an exactly opposite direction, and consequently screws itself inversely into an inoperative position.

This apparatus certainly presents some drawbacks. For example, the narrow slot in which the contact bar moves is capable of becoming easily clogged up, despite the orifices provided beneath each box; but, upon the whole, the idea is original as well as interesting.—For the above particulars and the illustration we are indebted to La Nature.



NEW SUBTERRANEAN CONTACT FOR ELECTRIC STREET CARS.

THE EISEMANN AND BOSCH SYSTEMS OF ELECTRIC IGNITION.

The accompanying drawings will enable the general arrangement and principles both of the Eisemann and the new Bosch systems of electric ignition, to which we referred in our issue of April 25, and in connection with the Exhibition at the Agricultural Hall, to be understood in detail.

Fig. 1 illustrates diagrammatically the Eisemann ignition, Fig. 2 similarly showing the new Bosch ignition as arranged for four and one cylinders, respectively.

As our readers are already aware, the Eisemann ignition is practically a coil ignition in which the battery is replaced by a magneto generator. Referring to Fig. 1, which shows the Eisemann ignition arranged for four cylinders, M is the field magnet of the magneto, the armature of which, M^1, is mounted on a shaft connected by the spur wheels, W and W^1, with a separate shaft parallel to it, and driven at half-speed—the same speed as that of the cam-shaft of the engine—and carrying on its far end the high-tension commutator, D. The spur wheel, W, is not rigid with the armature shaft, but is integral with a sleeve carrying the pulley, T^1, the sleeve driving the armature shaft by means of a pin, T^2, a fork, T, connected with a bell-crank lever controlling the movements of the sleeve. This part of the apparatus, as will be described later, is for controlling the moment of ignition. The ends of the armature winding are connected to the two connecting rings, M^2 and M^3, with which the spring connecting brushes, P^1 and P^2, make contact. The current passes through the conductor, P, from the brush, P^1, to the primary winding of the coil, and through the contact breaker, P^3, P^4, back to the brush, P^2. The contact breaker, P^4, is operated by the double cam, M^4, which, as the spur wheel, W, is designed to run at twice the speed of W^1, breaks contact four times for every revolution of the cam-shaft of the engine. A condenser, C, is arranged across the contact breaker so as to increase the secondary spark in the usual way. The condenser is shown connected to P^3 and P^4 by thin lines, but in practice it is of importance that the wire to the condenser should be at least as thick as the primary winding of the induction coil. One end of the secondary coil, S, is grounded and the other is connected to S^1, the brush of the revolving high-tension commutator or distributor, P. It will, of course, be understood that the current furnished by the armature, M^1, is an alternating one, but the cam, M^4, is so arranged that the circuit is only broken when the current furnished by the armature is at its maximum in either direction. The high-tension commutator or distributor, D, receives current through the brush, S^1, which runs on a metal ring forming the periphery of the wheel. This is in conducting connection with the segment, D^1, which makes consecutive contact with each of the brushes, D^2, leading to the sparking plugs, F^1, F^2, F^3, F^4.

The moment of sparking is determined by the breaking of the contact, P^3, P^4, the contact to any one of the brushes, D^2, having been made by the segment, D^1, slightly before that instant arrived, the connection being also maintained slightly after the spark has passed. This enables the spark to be advanced or retarded within the necessary limits by simply advancing or retarding the moment at which the contact breaker, P^4, is raised. The timing is effected by the

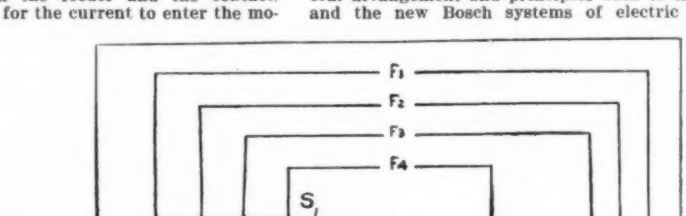


Fig. 1.—DIAGRAM SHOWING THE EISEMANN MAGNETO HIGH-TENSION IGNITION SYSTEM.

Fig. 2.—DIAGRAM SHOWING THE BOSCH MAGNETO HIGH-TENSION IGNITION SYSTEM.

fork, T, engaging with the guide pulley, T^3; moving this to the right or left rocks the shaft carrying the cam, M^4, and the armature, relatively to the spur wheel, W, and by moving T^1 to the right or left the moment of ignition may be varied as required.

The Eisemann ignition, it will be observed, has two very marked good points: it enables the battery, which is so often a source of trouble, to be dispensed with, and is as independent and reliable, therefore, as an ordinary low-tension magneto; and it gets rid of all the difficulties connected with the make and break contacts mechanically operated inside the cylinder. There is, therefore, no difficulty in accurately synchronizing the spark in all four cylinders, so that it may be said to comprise both the advantages of induction coil and ordinary magneto systems.

The new Bosch ignition is illustrated as applied to four cylinders in Fig. 2, in which the permanent field-magnet is shown upside down, for the purpose of enabling the different parts and connections to be better seen. The armature, A, which is stationary, is provided with two windings, A^1 and A^2, of which A^1 is of stout wire, and corresponds to the primary winding of an induction coil, A^2, being of fine wire and corresponding to the secondary. For the sake of convenience it is shown nearly at right angles to its real position. One end of the winding, A^2, is grounded on the shaft of the apparatus, and the secondary winding forms a continuation of the primary. The other end of the primary winding, A^1, is led to one side of the contact breaker, B^3, and to one terminal of the condenser, the other terminal of the condenser and the moving arm of the contact-breaker, B^3, being grounded.

As in the low-tension forms of Bosch magneto, the changes of magnetism in the armature core, which give rise to the current, are produced by the rotation of a soft iron sleeve, B, which partially surrounds it, and is integral with the hollow shaft, B^1, which also carries the notched disk, B^2, and the high-tension distributing disk, D. The action of the sleeve, B, is exactly the same as in the case of the low-tension magneto, but as some readers may not be familiar with it, it may be as well to recall it. If the sleeve, B, entirely encircled the armature, it would shield it completely from the action of the field magnet. It is, however, slotted, and when the slots come opposite the poles of the field magnet, the armature receives magnetism from the field magnet, and is deprived of it again as the slots pass around with great rapidity, and a powerful current is consequently induced in its windings. The contacts of the contact-breaker, B^3, are normally held together by the action of the disk, B^2, and during these periods the low-tension winding, A^1, is closed on itself, so that a powerful current flows through it at the moments when the magnetism of its core is being varied by the rotating sleeve, B. When one of the notches in B^2, which are steep on one side and beveled on the other, come under the lower end of the contact lever arm, B^3, the latter snaps back, owing to the action of its spring, separates the two contacts, and breaks the circuit of A^1. This produces a high-tension current in the secondary, or fine wire winding, A^2, just as in an ordinary induction coil, the condenser, C, increasing the effect in the well-known way. As the secondary winding is connected to the primary as already described, and as it is grounded through it, successively connecting the central rods of the sparking plugs, F^1, F^2, F^3, F^4, to the opposite end of the secondary, A^2, causes sparks to pass in the four cylinders at the right moments, the tension or voltage of the primary and secondary being added to one another. The distribution is effected by the commutator, or distributor, D. This consists of the rotating disk, D, carrying the metal plate, A^2, which is in conducting connection with the insulated end of the secondary winding, A^2. As the disk revolves this metal plate makes contact successively with the fixed brushes, 1, 2, 3, 4, which it does in each case just before the notches in B^2 cause B^3 to break the primary circuit, A^1. Sparks take place successively at the right moments accordingly in the four cylinders. The new Bosch ignition may claim practically the same advantages as the Eisemann, and is more compact, not having a separate induction-coil. The main relative advantage possessed by the latter apparatus, as shown, would appear to be the possibility of advancing or retarding the moment of sparking in the manner described. That, however, could be easily applied to the Bosch system by making the hollow shaft, B^1, displaceable relatively to the engine shaft in practically the same way.

It has been claimed for the new Bosch ignition that it acts in very much the same way as a high-tension spark in combination with the electric arc, the high-tension spark being used to start the arc, which then follows across the path which the high-tension spark has opened up for it with, of course, a vastly greater volume and heating power than that possessed by the spark which started it. It is hardly possible, however, that this can be the case, for the relatively great "thickness," that is to say, in reality amperage of low-tension sparks, as compared with high tension, is due to the small self-induction in the circuits which produce them. In this case, however, the self-induction of the secondary is added to that of the primary, and the amperage or volume of the spark cannot be seriously greater than that which the high tension winding would of itself allow to pass.—The Automotor Journal.

DETERMINING NEUTRALIZATION POINTS BY CONDUCTIVITY MEASUREMENTS.

Recent experiments by F. W. Küster and M. Grübers (see Zeitschrift f. anorg. Chem.) show that whenever the use of colorimetric indicators is impossible on account of deposits or colorations, the neutralization point is readily and with a perfect definition noted by means of measurements of the conductivity. Solutions adjusted with an indicator for hydroxyl ions (phenolphthalein) do not give perfectly true results in the case of an indicator for hydrogen ions (methyl orange) being used, the departures being dependent on the concentration (the volume) and the presence of neutral salts (sodium chloride, etc.). With phenolphthalein as an indicator, barite water should only be used for accurate titrations, whereas sodium and potassium hydroxides, on account of the variable percentage in carbonate, give departures depending in an uncontrollable way on accidental circumstances. In solutions devoid of carbonate, phenolphthalein will give transitions practically coinciding with the true neutral point. Methyl orange is less sensitive, its sensitiveness varying under the influence of different factors.

A. G.

SAFEGUARDS AGAINST LIGHTNING.*

By Alfred Hands.

The number of buildings damaged by lightning in this country (Great Britain) varies slightly from one year to another, but is so far constant that it is perfectly safe to say that in the course of any 10 years between 3,000 and 4,000 suffer from this cause, of which about 200 are churches. Statistics that have been published show that thunderstorms are gradually increasing over the whole of civilized Europe. Thus, in the course of 60 years, the average number of such storms in London has increased from 12 to 22 per annum. Considering the number of lightning discharges in these storms, it appears evident that damage would be very much more frequent if it were not for the number of lightning conductors in use. Conductors, however, are not always successful. They sometimes fail when they appear to have been applied in accordance with the better known rules supposed to govern the subject. On the other hand, cases occur in which conductors that would be condemned as inefficient under those same rules answer perfectly when struck by lightning. This anomalous state of affairs shows that there is some important factor that is very frequently overlooked, and which must be the crux of the question. Probably one of the causes that interfere with a clear conception of the methods necessary for protection is the view that is often taken as to what a discharge of lightning is.

At the best lightning is too often regarded as an electric current overcoming the resistance of the air; but this resistance has nothing in common with that which is the subject of Ohm's law, and to consider it merely as a momentary current is apt, I think, to give a somewhat misleading view of the matter. I want you to regard it as a breakdown of the dielectric—not as something leaving the sky to come to earth, or as being hurled from the clouds to strike a building, but to consider it—as it indeed is—as a fracture or cracking both of the air and of any other resisting medium between the oppositely charged bodies, the clouds and the earth. As a mechanical analogue, one may liken the air under these conditions to a thick slab of glass subjected to an enormous pressure from above and below, and which will crack when the pressure is greater than the material will bear. A building may be considered as a weaker object firmly embedded in the glass. We may, in fact, regard ourselves as living between the inner and outer coatings of an enormous Leyden jar or other condenser. Now, when the stress to which the air is subjected has reached the breaking point, which is about half a gramme weight per square centimeter, the line of the fracture becomes visible by the intense heat making the air particles momentarily incandescent, and this we call "lightning." The building which, being in the line of the strain, gets damaged, forms only a part of the fracture; the air is equally damaged, but is a self-repairing medium. Unfortunately, our buildings, trees, and bodies, which are less resisting than the air, are not self-repairing, and so we get the deplorable losses of life and property that occur every year. A building offers less resistance than the surrounding air, therefore the breakdown would tend to go through a building rather than pass it by and go through the air beside it, even if there were no metals in it to render it still more weak.

Even allowing for the effects of induction, lightning can no more be attracted by a conductor than a crack across a sheet of glass can be attracted by any weak part which would cause it to take other than a straight course. At the top the conductor would be provided with a point, or several points, so as to prevent the discharge occurring, if possible; and, if not, to try and render it less violent. As regards the lower part, if it ended at the ground line the conductor would answer, provided there had been rain and the surface of the ground was wet; but if the flash occurred in dry weather, there would be resistance to overcome between the conductor and the conducting stratum below, causing heat, and the least that would happen would be that the ground at this point would be blown up. This might be considered not worth the expense of making a good earth connection to prevent; but one cannot be certain that this would be the only effect. The explosive force in such a case is often equal to that of some pounds of gunpowder, and so there is danger of damage to the brickwork or foundation. A fairly good earth connection is therefore advisable, but it need not be a "perfect earth;" so long as the resistance is fairly low, and the conductor is of such a size as not to be fused, we can feel confident that it will answer in this case. It must not be supposed that I am stating that a good "earth" is never necessary; in very many cases, it most certainly is. A discharge would not leave a conductor even if there was a fairly high resistance, to go to earth by another route unless there was a rival one open to it. By a good "earth" I mean one that has a low resistance in comparison with any other possible "earth" in its neighborhood. Now, suppose that instead of the structure being composed of a solid mass of bricks or stone, it was made hollow, with a stone staircase in the interior and a gas pipe carried up to afford light at intervals. There would then be a rival conductor in the interior with a perfect earth connection, and the discharge would either be entirely diverted to the gas pipe, or be divided between the conductor proper on the exterior and the accidental one in the interior, according as the resistance of the former was great or small. There would be a side flash, or a side fracture, between the two conductors, if the brickwork or air between, as the case might be, was not sufficiently strong to resist the stress suddenly thrown upon it. It would be necessary, then, besides having a perfect "earth," to place the conductor so that there should be a sufficiently strong buffer of resisting material between the two as to make it impossible for the discharge to break through. I do not mean by this the use of glass insulators or keeping the conductor a few inches away from the wall, but by a considerable space of resisting material. Side flash, or sparking, will occur between a struck conductor and other metals sufficiently near it. A perfect "earth" does not prevent side flash, it only reduces the sparking distance; a comparatively bad "earth" increases it. Other metals must be at a safe distance, or connections made across to act as a conductor for the spark. I have reasons for fixing the safe distance between two perfectly "earthed" conductors, in the most extreme cases, as five feet for ordinary building materials, while in some cases, depending on the course of the accidental conductor, it is considerably less.

Unfortunately metals are introduced very largely into the construction of modern buildings. Metal cowls or chimneys, lead flashing round chimney bases, rain-water pipes and gutters, fire grates, girders, gas and water-supply pipes, etc., form a most complicated problem. I have found that on an average about a dozen cases of failure of conductors occur in this country every year. Cases of failure may be divided into five main classes or headings. (1) Where the conductor is not touched, the discharge taking an entirely different course. (2) In which the conductor is struck, and damage occurs, owing to the non-compliance with the more elementary rules appertaining to the subject. The ground may be blown up, owing to a very high resistance, the conductor may be broken or fused at a bad joint, or it may be torn loose, owing to a bad bend. (3) Where a part or the whole of the discharge leaves the conductor and takes another course through accidental conductors to earth. Such cases often result in very serious damage. If inflammable materials happen to lie in the path, the risk of destruction of the building by fire is very great. (4) Where sparks occur between lightning conductors and neighboring metals not leading to earth. These cases do not usually result in very serious damage, unless fire is caused by something inflammable in the line of the spark. (5) Where there is no side flash from the conductor, but sparks occur between two metals distinct from the conductor. These cases are, fortunately, not very common. They are apt to cause fires; in fact, it is often the setting of the building on fire that shows such an effect has occurred.

A fact which, although generally known to electricians, is frequently overlooked, is that all metals are conductors of lightning, the difference in conductivity between one kind of metal and another being in this connection a factor of very little moment; also, that the accidental conductors about a building require just as careful consideration as the intended conductors, and in some cases even more. Too little attention is given to the fact that the question of its efficiency, or non-efficiency, depends on the way in which it is applied, rather than on the conductor itself. The part that often makes the difference between efficiency and non-efficiency is the making of various connections to bridge over what I call sparking gaps, as well as keeping a safe distance away from metals that it would be dangerous to connect to. It is difficult to set any rule as to the places where connections have to be made. They can only be judged by consideration of the conditions that would exist at the moment of discharge. I may, however, say, that they would be the places where there would be great differences of potential. A spark is, of course, the outward and visible sign of a difference of potential. If this difference is not sufficiently great for the sparks to bridge the gap between the two metals, no effect will occur. At the moment of a lightning discharge, the effect cannot begin and end just at the one spot struck; there must be waves of potential, if I may use the term, set in motion, and the effect would be visible as a spark at places where one metal approached another, provided they happened to be set in just the right manner. These effects are not very serious, as a rule, but they may cause fires if the conditions are suitable, and they therefore require guarding against by connections at the critical points. If you were to cover a building completely with metal from the top of the chimneys down to the ground line, making earth connections on each side, you would have a sort of metal case, inside which no electrical effects would occur. You might have metal ramifications of all kinds, but there would be no sparks within the structure. It would not even be necessary to have the structure entirely covered with metal. One might run a large number of wires over it, both vertically and horizontally, so as to make a metal cage, and obtain the same effect, provided that no metal was allowed to pass into the building from the outside without being connected to the cage; but the meshes formed by the wires would require to be comparatively small. It would not be sufficient to run just a few conductors over it, and so get a sort of skeleton cage. There is a case on record which shows that this does not afford metal screening. For very dangerous places, such as explosive magazines and factories, metal screening is generally the best, and often the only safe course to adopt; but for other buildings, I think the enormous expense and unsightly appearance of the cage system of protection would render it impossible of general adoption. In arranging a conductor system it must be borne in mind that there are certain parts of a building that are exposed to be struck, and therefore the system must comprise lines of conduction from all those parts. To protect one and leave another exposed is waste of money.

Earth plates should be proportionate to the moisture in the soil, never less than three feet square, or equivalent area, in a wet situation, while in drier ones the plates must be increased in area proportionately. In somewhat dry soils resistance may be reduced by bedding the earth plates in coke, but coke should not be used unless it is absolutely necessary. As regards the best kind of conductor to use, I consider that, taking into consideration durability and cheapness, copper is the most suitable metal, and, as

* Abstract of paper read before the Fire Prevention Congress in London, July 6, 1903.

regards form, copper tape, band or ribbon, as it is indiscriminately called, is the best for similar reasons. Copper rope answers sufficiently well for a time, but it is not so lasting as tape.

THE DECLINE OF BRONZE.

IMITATION is the order of the day; cheapening of all products follows upon its heel. Outward show, both in man and things, is supreme, and intrinsic worth has been relegated to the rear.

Are we progressing or are we simply learning to be satisfied with hollow shams, whose exterior only represents pretended worth? Every branch of industry suffers from this desire to deceive, nor is this failing anywhere more apparent than in the bronze technic.

In the days of classic art bronze was reckoned among the noble or precious metals. Bronze was universally appreciated and no one thought to possess a more highly valued ornament than a genuine bronze. Is this the case to-day? Only in a measure can the answer be yes! The true worth of bronze is just now but little understood, but, among the very few, whose means permit them to gratify expensive tastes, it may yet be possible to find a genuine bronze.

Yet "bronzes" were never more generally affected than they are at the present time. Scarcely the poorest family but has among its *lares et penates* at least one piece of what purports to be bronze. *Cuivre poli* has supplanted the nobler metal, but *cuivre poli* is not bronze. This, then, leads up to the question, What is bronze? Bronze is an alloy of copper and tin, the brass of the ancients. The quality of bronze depends upon the percentage of its component parts. It is made up, ranging all the way from 12 parts of copper to 1 of tin, down to 2 parts of copper to 1 of tin, depending altogether upon the purposes for which the alloy is to be used.

Small percentages of zinc and lead have also been added. The discovery that these softer metals would mix with copper was the prime agent in the decline of real bronze, for besides being cheaper they reduce the fusing point materially and thus avoid the danger of burning away; again, more perfect castings are obtained with these weaker alloys. Two causes, we see, thus effected the downfall of bronze; the increase in the amount of zinc used, and the decrease in the amount of copper. However, the rich brown tone, from which no doubt the name bronze is derived, can only be obtained from the red metal. Moreover, the more copper there is the firmer, the more malleable, the more ductile is the alloy, and, need we add, the more costly. Such a state were indeed bad enough, yet it is in reality even worse. For "bronzes" now, at least 99 per cent of them, have no copper in them at all, but on them. By this we mean that a common zinc casting provides the figure and a very thin plating of copper deposited galvanically upon the outside serves to captivate the eye and furnish the only excuse for calling it bronze. Even the patina, that glory of bronze, which is formed by age and is the oxidation produced by the air upon the surface, is now artificially produced, so that a white casting, within a few hours, to use a natural simile, sprouts leaves, buds out, and finally comes forth in the glorious envelope of a statue centuries old. This may be deemed the greatest outrage practised upon the unsuspecting purchaser.

That "all that glitters is not gold" was never more truthfully said than of the gilt bronze now *en vogue;* after fifty years we have returned to the tastes of our grandmothers. It glitters, however, and it looks like gold; it satisfies the desire and causes a sensation of the beautiful. Is that not enough? Nay, more, it does even better; it makes trade without deception, for the veriest tyro knows that fire gilt is neither gold nor bronze. Yet the whiter the metal and the more brilliant it becomes, the further it departs from bronze; in other words, the greater the decline in bronze.

For bronze, when once clothed in its rich brown coat, when once it dons its beautiful patina, with which nature endows it to resist the corroding influences of time, does not sparkle, does not scintillate, but passes adown the ages ever presenting the same dignified, subdued, mellow aspect, as pleasing to the eye to-day as it was enchanting to our brethren and sisters 3,000 years ago; unchanged, unchanging, everlasting. For proof of this, notice the ancient statues preserved in our museums or the unearthed brazen tablets cast or inscribed when civilization upon this earth was yet young. Counteracting influences sometimes remove the patina or perhaps prevent it from forming. In cities where the air is surcharged with soot from soft coal bronzes occasionally do not attain a complete coat or patina. One of the most beautiful bronze monuments in the world, surely the most expensive specimen of bronze *alto relievo* of modern times, the martial statue of Frederick the Great and his generals, at Berlin, is a conspicuous example of this. This statue scales off under the biting influence of the creosote in the soot. This is, however, not general all over Berlin, for the statues in front of the museum are not thus affected, nor are the smaller ornaments in the palaces subject to such corrosion.

In place of this everlasting bronze we now ornament our salons and boudoirs with *cuivre poli, fire-gilt* and *fake bronze* upon which a little copper and an artificial patina have been deposited and spread on.

A noted artist of Berlin, Elkan by name, spent many years in Japan investigating the bronze technic of those original people. On his return to his native land he at first deserved much of his countrymen for again ennobling an almost lost art. But Mr. Elkan, though an artist of repute, is a merchant as well, that is, he not only possesses a desire for fame but is dominated by a desire for gain also. Taking advantage of the small knowledge of real bronze possessed by the people he carried the chase after gloss and shine so far that he increased the faintly reddish coloring in the Japanese bronzes to such a degree as actually to place copper-red bronzes on the market, thus stimulating the famous Barbedienne, who, bowing to the taste of the time, gave us the gold-bronze.

Another symptom of decay in the bronze technic is the gradual disappearance of articles of beaten copper. It hardly admits of contention that the art of beating copper into shape stood, from an æsthetic viewpoint, upon a plane far above the mere casting of it into molds.

Extant bronzes of the ancient Etruscans, who excelled in the art, are mostly beaten, rarely if ever cast. Indeed, it seems that the more the peoples developed in other industries the more they returned to the bronze technic.

As engraving and chasing, useful and necessary in themselves, became more and more overdone the bronze technic declined.

A characteristic of the surface of good, solid, well-worked bronze is roughness and unevenness; in this respect it approaches well-wrought iron. After handling *cuivre poli* and brass our sense of feeling became spoiled and it became our endeavor to approach the bronze as near as possible to this state, not only to cause it to shine like gold but to be as soft and as smooth to the feel as brass. At the same time ornaments of gold and silver were highly polished and every mark of the tool eliminated. With regret it must be acknowledged that the famous Barbedienne also succumbed to the depraved taste of the time. Of late, however, a revolution has taken place and, forsooth, in that land whose inhabitants, not without cause, perhaps, boast of still possessing some æsthetic taste—in France. Yes, in France, and to-day can be found some real bronzes, which contain a goodly percentage of copper and are not covered all over with chasings—bronzes conceived and worked out by the brains and hands of real artists.—Edelmetall-Industrie.

PRACTICAL METHOD OF COUNTERFEITING ANTIQUE SILVER.

IN an era when the rage is for new old things, the searcher after antiquities in art must be permitted to see *con suo proprio occhio* the imprint of age upon the surface. From his standpoint, absolute confidence is no longer to be placed in the assurances of the merchant. The collector feels before he buys that there is always danger of deception, but as an expert in these things he fancies he is not to be lightly taken in.

To supply a never-ending demand soon exhausts the ancient supply and recourse must be had to duplication; duplicates are new, and to make them old, at least in appearance, we furnish herewith an excellent process, together with the requisite formulæ.

In a small alembic dissolve 10 parts of quicksilver in 10 parts of concentrated nitric acid and 30 parts of water. In this solution dip the silver objects, which have previously been treated to the potassium cyanide bath and well rinsed off with clean water.

The object of this is to amalgamate the surface of the silver. Now, after another thorough rinsing, the objects may be placed in a pickling bath made up after the following formula:

In a liter of water dissolve, cold, 25 grains of silver sulphide and 10 grains of ammonium carbonate. The moment the already amalgamated object comes in contact with this solution a dark film begins to form upon its surface, which becomes the more intense the longer the solution is permitted to act upon the object. At first a brown tone is perceptible, which, as the minutes pass by, changes to black and later reaches a deep blue-black tint.

That comprises the whole process; but the artistic results to be obtained thereby, and results which counterfeit the natural oxidation most nearly, depend altogether upon the length of time the object is in the bath. To know the exact second for removal, therein consists the art.

After removing the object must again be thoroughly cleansed with pure water, and further subjected to treatment with the finest powder of pumice stone.

It will be found better to do the rubbing with the finger tips rather than a brush because, in nature, only the higher or most prominent parts of the figure suffer from friction and will be worn or relieved of some of their dark brown coating.

The deeper lying portions must retain the blackest tints, which would not be the case if the bristles of a brush were allowed to reach them.

Use therefore no other polishing powder, for the aim must be to produce not a glossy but a dull, dead appearance.—Erfahrungen u. Erfindungen.

STUDIES OF BLOOD PRESSURE.

RESEARCH upon the blood pressure in human beings, on a scale broader and more thorough than any work of this kind yet done in America, has begun in the Massachusetts General Hospital in Boston. The subject has been studied for several years in Europe, but it is only recently that the importance of blood-pressure observations, both in surgical and in medical cases, has begun to take a firm place in the theory of medicine.

Dr. Richard C. Cabot, of the Harvard Medical School, who directs the new inquiry on the medical side, is well known in the profession for his studies on the blood. By the methods of pressure observation, he has already made a striking contribution to our knowledge of the therapeutic action of alcohol in fever cases, showing the surprising fact that in such cases the supposed stimulating effect of alcohol is practically nothing.

Dr. Cabot's work is not confined to the study of persons who are ill. A great deal remains to be done in establishing the reactions of the circulatory system in healthy persons, under the varying influences of food, exercise, baths, and the like. It has been clearly shown that the effect of a given circumstance is often very different in health from what it is in disease. The importance, then, of showing what are the normal reactions is plain. A comparison of these with reactions produced by the same circumstances in diseased states furnishes new and sound bases for an understanding of much in the bodily processes that is now obscure. For this reason there is what may be called a physiological side to Dr. Cabot's new work, and observations are being made upon healthy persons of both sexes and all ages, outside of the hospital.

The results of the studies have rather lessened the importance of the "feel" of the pulse to the physician's finger, replacing that test with an exact method which tells more than the most skillful touch. Variations of blood pressure indicate, somewhat as barometric changes mark the variations in the weather, the fluctuating conditions of the body. A "good circulation" is a condition of healthy activity and comfort, and this is to be had only through the maintenance of an adequate blood pressure. The conditions which govern blood pressure have been learned by such studies as are now going on. These conditions are primarily the pumping force of the heart; the elastic properties of the arteries, and their muscular fibers, whose action is controlled by the nerve station in the great bulb of the brain, called the vaso-motor center. Research has shown that the integrity of this last element is the most important of the three, and this discovery has had very striking results, to be presently mentioned, in the field of surgery.

For comprehension of the matter, a word should be added on the operation of the circulatory system. It is in brief a system of elastic tubes under the constant tension of the arterial elasticity, modified by the action of the muscular arterial fibers, as these are directed by the vaso-motor center, from which go out impulses which relax, contract, or maintain in any particular state of tension or laxness the muscular coat of the arteries. The elastic coat of the arteries is brought into play by the periodic on-flow of blood from the heart. Being elastic, the arteries expand under the pressure of this flow, and as the valves of the veins prevent a back-flow of the blood through the arteries, the elastic walls of the latter send forward in a fairly even flow through the capillaries, the blood received at each stroke of the heart-pump, between each stroke and the next.

The evidence pressure studies give of the action of drugs lies in the fact, chiefly, that fatigue of the vaso-motor center by the ordinary work of each day, and still more through the attacks of disease, tends to reduce the blood pressure and produce, at the best, a sense of weariness and fag. Here comes in an interesting bit of every-day therapeutics. Men, it is known, take readily to 5 o'clock tea. And the explanation as given by an English experimenter is that tea acts on the vaso-motor center as a stimulant, causes contraction of the arterial muscular coat, and restores the blood pressure to the normal from which fatigue tends to reduce it.

Imperfection of instruments has interfered with the success of previous blood-pressure studies. The instrument used by Dr. Cabot is a new one designed to register both maximum and minimum pressures, from which the significant mean pressure may easily be calculated. In principle, it is an elastic tube, to be placed around the upper arm and inflated with air until the pulse cannot be felt by the finger below it. In this state the air in the tube-bandage is of the same tension or pressure as the maximum pressure of the blood in the compressed artery. From the tube-bandage a rubber tube connecting with a glass tube carries the pressure of the confined air to the base of a mercury column, whose height shows the pressure of the bandage air, and hence the maximum blood pressure in the artery. A scale marked in millimeters makes it possible to record the varying pressures in figures, which can later be plotted on a chart. Instruments of different types give different mean pressures. That used by Dr. Cabot gives an average mean pressure in health of rather less than 100 millimeters. In animal experiments, an absolute figure can be obtained by inserting the tube of the mercury column, or manometer, directly into an artery. In human studies, however, the absolute pressure is not essential. What is required is pressures measured by the same standard, hence usable for comparison.

Besides Dr. Cabot's studies, there is going on both in the Massachusetts General and the city hospitals in Boston observations designed to test the new surgical methods proposed recently by Dr. George Crile, of Cleveland, and Dr. Harvey Cushing, of Baltimore. A series of experiments on animals, and later on human beings, led Dr. Crile to a new position as to the nature and treatment of surgical shock, a familiar accompaniment of severe surgical operations. Taking the elements which go to maintain normal blood pressure, Dr. Crile found that in profound shock, in which low blood pressure is the essential feature, neither the cardiac nerve centers nor the heart muscles were at fault. Similarly, the elastic quality of the arteries was found to be unimpaired. The condition of the arterial muscular coat was then tested by the administration of adrenalin, and an instant and great rise in the blood pressure showed that the muscular coat, which contracts under the influence of adrenalin, was likewise efficient. Saline infusion, so often resorted to, was found but slightly and only temporarily efficient.

Exhaustion of the vaso-motor center, the only remaining hypothesis, was supported by much positive evidence which seems conclusive. Strychnia has been a time-honored resort in surgical shock. Dr. Crile proved that this drug was a pure vaso-motor stimulant, and observation of the blood pressure in profound shock showed that strychnia had no effect in raising the pressure. In health it does raise the pressure, but successive doses exhaust the vaso-motor center, and Dr. Crile at last found administration of strychnia in physiologic doses the best way of producing shock in animals for experimental purposes.

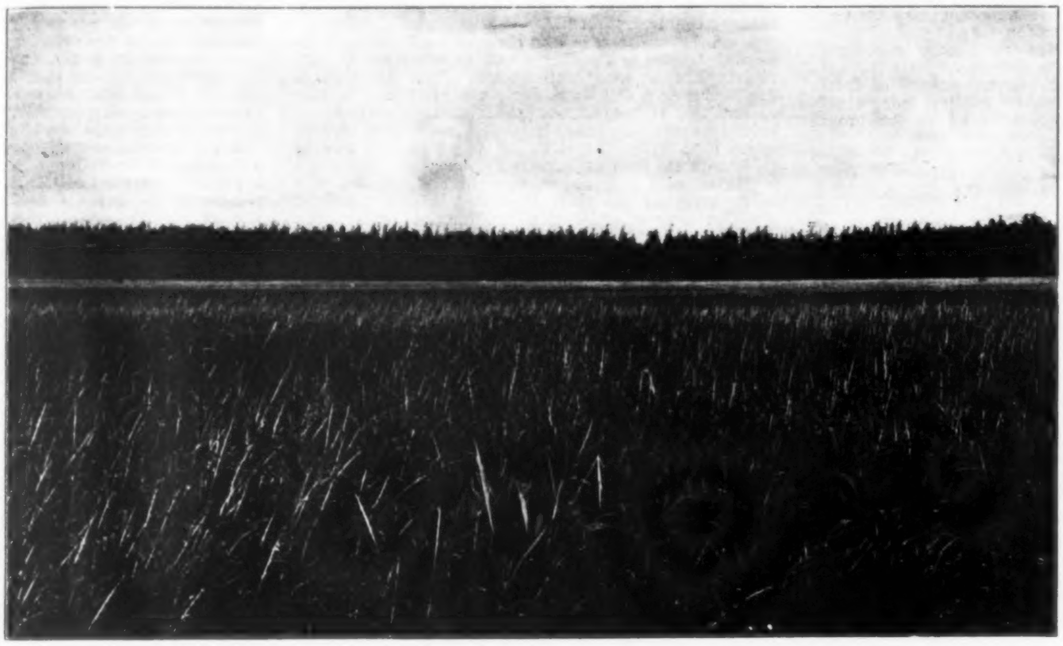
This conclusion strikes at the root of present practice. It was also found that pressure distributed over the surface of the body forced onward to the heart the blood which in shock, as after death, tends to collect in the veins and so aids the maintenance of circulation. A pneumatic suit was found of distinct value in clinical use; and this, with the administration of adrenalin in saline solution, makes up the essence of Dr. Crile's contribution. His ideas are now being tested by thorough observations in this city, and the outcome may be expected to have a wide influence.

Observation of blood pressures is also of great importance in surgery, as indicating the ability of a patient to withstand an operation, by showing the danger line in anæsthesia, and in gaging the patient's resistance during an operation. All these points indicate a rapidly extending appeal to it.—The Evening Post.

WILD RICE: ITS USES AND PROPAGATION.*

By EDGAR BROWN and CARL S. SCOFIELD.

THE seed of wild rice has been used for food by the Indians, particularly those of the middle Northwest, as long ago, at least, as the first acquaintance of the white man with their customs. Notwithstanding the abundance of other forms of cereal food, such as flour and corn meal, since the advent of the white man, the Indian of the upper Mississippi Valley has continued to use large quantities of wild rice, and this, too, in spite of the fact that the harvesting and curing of the seed require considerable arduous labor. Wild rice, as prepared for food by the Indians, is highly esteemed by the white men who have had the opportunity of testing it, and the entire available supply now sells at from two to three times the price of ordinary white rice.



FIELD OF WILD RICE JUST HEADING OUT, NEAR BEMIDJI, MINN.

While by far the largest demand for information regarding this plant has come from men or organizations wishing to secure viable seed for planting near shooting grounds to attract wild fowl, the possibility of preparing from the seed a large and regular supply of a nutritious and highly-flavored cereal food has received some attention. The importance of maintaining good feeding grounds for wild fowl, of which the propagation of wild rice is a very important element, needs no discussion, and the desirability of propagating a plant which will make the otherwise waste-water areas of the upper Mississippi Valley yield a valuable and highly esteemed cereal is also evident.

The wild rice plant (*Zizania aquatica* L.) occurs naturally over a wide area in the United States and southern Canada. The same species is also reported from Japan, Formosa, and China. It finds its best environment in the United States in fresh-water lakes and river sloughs and along the seacoast where streams meet tidewater. It requires that the water in which it grows be fresh, that is, not brackish, and that it be neither quite stagnant nor too swiftly moving, and while it thrives on a wide variety of soils under these waters it does best where the bottoms are soft and muddy.

INDIAN WOMAN PARCHING WILD RICE.

FRESHLY GATHERED WILD RICE DRYING ON A SCAFFOLD.

The change in water level where the plant grows is an important item. For instance, it will frequently fail to do well or to grow at all in some of the northern lakes through which the Mississippi flows, especially if the annual change in water level in these lakes is more than two or three feet. There is on this account in the minds of some observers an opinion that wild rice normally grows only alternate years, or at least that it does not grow every year in a given locality. This idea is without foundation and its existence is probably due to the fact that occasional years of high water prevent the development of wild rice for that year, while a normal level the following year permits the regular growth.

This calls attention to the peculiar vitality of the seed of this plant. It is evident that if the growth of wild rice in a given locality is wholly prevented for a year by high water and there is an abundant growth the next year when the water level is normal, there must be a large proportion of the seed which remains dormant and viable for at least eighteen months after it reaches maturity.

In streams affected by tidewater, however, where the daily change of water level sometimes amounts to three feet or more, wild rice may grow vigorously. It is abundant along the shores of the lower Potomac, where it grows on mud flats that are nearly or quite exposed at low tide and submerged by two to three feet of water at high tide. The plant has in this case become adapted to this frequent change of water level, but if for any reason high water were retained over these beds for any considerable length of time during the early spring, the plants would hardly develop.

While it appears that wild rice will grow on a wide variety of soils, it needs for its best development approximately the following conditions:

Soft alluvial soil, covered with from twelve inches to four feet of water. The water level should not have an annual variation greater than eighteen or twenty inches. The water should be constantly freshened by slight movement and consequent aeration.

The wild-rice plant is an annual. It bears abundant crops of seeds which fall directly into the water as soon as ripe and lie buried in the mud below until the following spring when, if conditions are favorable, they germinate and produce new plants. In the northern lakes the long ribbon-like leaves appear floating upon the surface of the water late in May. By the latter part of June the stems have grown sufficiently to raise the leaves above the water. In the South the growth starts much earlier. On the mud flats of the lower Potomac the plants may be 6 inches high by the 1st of May. Strange as it may seem, the period of flowering and ripening of wild rice is almost the same in northern Minnesota and along the Potomac River near Washington, though on account of the earlier start in the southern region the period of growth is much longer.

The panicles appear during the latter part of July, and the flowers open immediately. The glumes of the pistillate flowers separate at the base to allow the stigmas to protrude and be pollinated, and closing again soon after fertilization is accomplished, leave the withered stigmas outside. Immediately after fertilization the young seed begins to elongate, and gradually fills the space within the floral envelope. This development requires about two or three weeks, and as soon as it is completed the connection with the stem is weakened and the seed falls off. The time of maturing of the different seeds in a single panicle extends over several days, the seeds on the tips of the branches ripening first.

The seeds, on falling, usually strike the water with the point of attachment below and sink immediately to the bottom. If by accident the distal end strikes first, enough small particles of air are caught by the barbs borne there to keep the seed on the surface of the water for a time, but as these air bubbles escape the seed sinks.

Almost all the wild rice seed now harvested is gathered by Indians into birch-bark canoes. This is done usually by two persons working together, one standing in the bow of the canoe and propelling it with a forked stick, and the other seated in the stern with two short sticks, by means of which the plants on either side of the canoe are gently pulled over it and the ripe seed beaten off. No attempt is made to get all the seed off the plants at one time. It is customary rather to take only the seed which falls readily and to visit the same plants later as more seeds ripen. The period of ripening extends over nearly two weeks for any field and over several days for any single plant, so that were one to attempt to harvest all the rice on a given area it would be necessary to go over that area at least four or five times at intervals of from two to three days. Recently some attempts have been made to construct machinery for harvesting wild rice seed from boats driven by propellers or drawn by cables. So far, however, such endeavors have not been entirely successful.

It is customary in some sections for the Indians to prepare wild rice for harvesting by going through the field before any of the seed is quite ripe and drawing the heads of adjacent plants into bunches, which are

* Bulletin No. 50 of Bureau of Plant Industry, Dept. of Agriculture.

firmly tied together, so that the seed, as it ripens, will not fall. This custom, however, is not universal, and is only resorted to when the supply of wild rice is not abundant and it is desirable to gather as much as possible from certain fields. When a portion of a field is so tied up, it can be left until after all the untied seed has been harvested or has fallen, and in this way the harvesting period is extended. This preliminary tying is, of course, a tedious operation, and would be expensive were the time of the operator a salable quantity. The harvesting of wild rice is not regarded by the Indians as a particularly arduous task, though attempts by white men to do the same work have not proved very successful.

After the wild-rice seed is harvested into the canoe, it is taken ashore and put in piles or spread out for a preliminary drying. If allowed to remain piled up for more than a few hours when fresh, fermentation sets in, as the seed is very damp and soft when gathered, so that almost immediately after it is harvested it is either spread out thinly to dry, or is parched ready for hulling. The parching is at present done by the Indians in a very primitive way. The seed is put into a kettle over a slow fire and stirred with a stick until it is roasted so that the hull is brittle enough to be easily broken. Not much more than a half bushel can be parched at a time, and it requires from half an hour to an hour to parch a single lot, and the seed demands constant attention throughout the parching process to keep it from burning. Unless stirred evenly the kernels pop open or become so brittle as to break up badly in the subsequent hulling process. There is a most excellent opportunity for the development of some simple device for the uniform parching of wild-rice seed. The parching is what gives the seed its highly esteemed flavor as a food, and if this operation and the subsequent hulling can be done uniformly the percentage of burned and broken seed will be much less than at present, and, furthermore, the cost of production of the food will be very greatly reduced.

After the seed has been parched it is spread out to cool, and soon after it is hulled. The hulling is at present the most tedious operation in the whole process of preparation. The Indians ordinarily accomplish it by putting about a bushel of the seed into a hole in the ground, lined with cedar staves or burnt clay, and then beating or punching it with heavy sticks. Often three or four men work together on one lot. After the seed has been beaten until the hulls have all been cracked or broken, the grains and hulls are separated by tossing the mixture up into the wind from light birch-bark baskets. After the parching and hulling are finished the grain is sufficiently dry to keep indefinitely.

As a food material this parched wild rice is highly esteemed by those who like the "gamy" flavor which it acquires by parching. It is cooked with wild fowl and also used as a breakfast food. For either purpose it should have several preliminary washings in cold water to remove any disagreeable smoky taste. It is also used to a limited extent for making rice cakes. For this purpose it is milled and the darker outer coat is sifted out. When milled without being parched this outer coat is difficult to remove, as it breaks up into small particles that do not readily separate from the flour, so that for all use as food the seed should be first parched and hulled.

When wild-rice seed is to be used for propagating purposes it is now customary to secure it from Indians as soon as possible after it is harvested, and to spread it out thinly over some sort of a floor in the shade and stir it frequently until it is dry. Since it has been extremely difficult to germinate seed so treated, or to secure successful plantings from seed obtained upon the market, there is good reason for believing that it is the present methods of curing seed that are at fault. It was largely for the purpose of determining where this fault lay and how best to remedy it that investigations were instituted. It is true that many of the unsuccessful plantings made during the past owe their failure to the improper selection of the place for planting, due to ignorance regarding the nature of the plant and its environmental requirements; but it is certainly true that the plant may grow in many localities where it is not now found, provided good seed is obtainable.

Some instances are reported where successful plantings have been made, but the greater number have proved entire failures. This is no doubt due to the fact that the seed which is ordinarily obtained from the Indians is treated in such a manner as to kill the germ. It is allowed to ferment during the curing process or to become too dry, either of which conditions seriously injures its vitality. Practically all attempts to germinate thoroughly dried seed have proved unsuccessful.

In order to determine the best methods to be used in curing, storing, and planting the seed, a series of plantings was made both in northern Minnesota and at Washington, D. C. The seed was collected fresh and planted in tubs of mud sunk into the muddy bottoms where wild rice naturally grows. The tubs were covered with fine screens to prevent other seeds getting in and to prevent the removal or destruction of the seed planted. These plantings were examined from time to time. No signs of germination were noticed in the autumn immediately following the planting, but at the time the naturally sown seed around the tubs began to grow, in the spring of 1903, the seed in the tubs was found to be germinating freely, thus showing that when the seed is planted in a fresh condition and never allowed to heat or dry it will grow well.

A

B

C

WILD RICE SEED WITH THE HULL ON (C), WITH THE HULL OFF (B), AND PARCHED (A). (NATURAL SIZE.)

Plantings were also made by Mr. D. W. Hallam, of Dover, N. H., in a number of ponds where wild rice had never grown. In some the seed was planted in the fall of 1902, and in others in the spring of 1903. These ponds were visited the second week in June, 1903, and the plants were found to be growing well in all cases.

Mr. Hallam has succeeded in keeping wild rice seed over winter with its vitality uninjured. The following extract from a letter from him under date of April 15, 1903, shows how this was done:

"The wild rice was ordered with instructions to ship as soon as gathered without drying. I received it on the 27th day of October, 1902. The barrel was placed on end in the shade out-of-doors, the head taken out, with about a bushel of seed, and a faucet was put in at the bottom to drain the water. The seed was weighted with a cover, and cold water enough to fill the barrel put in each morning and drained out daily. The barrel was kept full. On the 5th of December ice began to form on the inside of the barrel. Care was taken in adding water so as not to burst the barrel. By the 25th of December there was a frozen mass of ice and seed that filled the barrel. No water was then added until the middle of March, and then only enough to keep the barrel full, for as yet there was quite a mass of ice and seed. Since April began it has been necessary to change the water daily. Our water here is quite cold, 45 deg. to 55 deg. F. I have sent a sample bottle."

The seed received from Mr. Hallam with this letter had germinated and had sprouts from one-half to one inch in length when it arrived. Later, a larger quantity of seed, about two quarts, was received from Mr. Hallam, of which 75 per cent had germinated.

It seems from the results of the experiments referred to that wild rice can be successfully grown from seed either by sowing the fresh seed as soon as it is gathered or by keeping it in water over the winter and sowing in the spring. In most instances it will no doubt be found more satisfactory to sow in the fall, provided the place sown can be protected from waterfowl and other animals likely to destroy the seed, since such a practice will avoid the trouble of keeping the seed wet during the winter. When the seed is kept in water either for storage or transportation, the water must be changed frequently or aerated, as fermentation sets in if it is allowed to stand any length of time.

The seed can be shipped or stored for a short time by packing it in dampened moss or excelsior, and this is a convenient way to prepare it for shipment. It is necessary to separate the seed from the moss or excelsior by layers of cloth, as it can not conveniently be sown when mixed with either. The package, when made up thus for shipment, must not be too thick or too tight to prevent some slight circulation of air, or fermentation will at once set in.

1. Orders should be placed before the harvesting season is commenced, so that the seed may be shipped immediately after it is gathered.
2. Care should be taken to gather only fully matured seed.
3. Seed should not be allowed to dry when it is to be used for propagation. For shipment or storage it must be kept wet, with frequent changes of water, or packed in damp moss or excelsior in ventilated packages.
4. Wherever practicable, autumn planting is recommended.
5. Care should be used in selecting the place for planting seed to get the proper depth of water—from one to three feet, with a thick layer of soft mud underneath—and the water should be neither quite stagnant nor too swiftly moving.

SPANISH OLIVE OIL.

During recent years efforts have been made to improve the quality of the olive oil produced in Spain, so as to enable it to compete in foreign markets with the French and Italian oils, which are so universally appreciated. Some measure of success has already attended these efforts, and this has encouraged the leading Spanish oil crushers to spend money on improvements in their machinery with, it is said, every prospect of a good return. In Barcelona, the pickling of green olives is an important branch of industry; besides the home consumption, which is large, about 7,000 tons are, according to Consul Lay, annually exported. The olives are packed either in bottles or kegs. For pickling, the olives are carefully selected; all those that are in the slightest degree bruised or damaged are rejected, as only the perfect fruit is capable of being preserved. The selected olives are then placed in fresh water to soak for a few days, care being taken to change the water frequently; they are then put into the pickling mixture, which is a solution of common salt and soda, the olives being entirely covered. This is the general method adopted, and though some may slightly alter the solution used, and add to it certain aromatic substances to flavor the olives, the basis of the preparation is invariably common salt and soda. Ripe and half-ripe olives are preserved only in small quantities, as there is little demand for them. Until quite recently little attention was paid to the method of extracting oil in Spain, and consequently in many parts the most primitive methods are still in use. It is usual for the small grower himself to extract the oil from the olives grown on his land; and as he frequently does not own the necessary appliances, he borrows them from the nearest town, paying for their use either in money or oil. These machines are of the most primitive description. The olives are first crushed in a mill turned by a horse or a bullock. They are then placed in lever presses and the oil thus extracted, boiling water being generally used in the process. These wooden presses, though powerful, are very slow, and it often happens that the olives have to be stored until the presses are available, with the result that fermentation sets in, and this naturally detracts from the quality of the oil. It is said

that there are between 3,000 and 4,000 of these presses in Spain. Formerly the pulp remaining in the presses was used as fodder or fuel, but now it is sold, and a second extraction of oil is made from it. There are sixty-three mills in Spain for extracting oil from this pulp. The largest oil manufacturers, especially those in the province of Catalonia, have been the first to recognize the importance of improving their machinery; the old crushing mills and wooden presses have been replaced by steel cylinders and hydraulic presses, so that not only is a greater yield obtained, but the quality of the oil is better. Nearly all the machinery in use is of Spanish make. After being extracted, the oil is run into earthenware jars or tin tanks, and after a certain time, strained. It is then poured out into receptacles to be kept until required, alcohol being sometimes used to keep off the action of the air. The lower grades of oil are used in the manufacture of common soap.—Journal of the Society of Arts.

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FUNCTIONS OF TECHNICAL SCIENCE IN EDUCATION FOR BUSINESS AND THE PROFESSIONS.

By Robert H. Thurston, Sibley College, Cornell University.

The responsibility of the State arises out of its duty to promote the welfare of the people of the State. This duty as respects the common school, the free public school, has long been admitted; it is now coming to be seen that higher education to-day is quite as necessary to the highest interests of the State, and even to its industrial progress, as was secondary education when the latter was inaugurated as a fundamental purpose of statecraft, a primary object of legislation. Of these two divisions of this great task of the State, Germany exhibits the finest example of the higher, the United States, of all nations, the most admirable example of the lower. But the higher, and especially the technical, education of all competent to profit by it effectively, is now recognized as an essential which only the State can supply fully, continuously, and without distinction of class of citizen.

The State, therefore, inaugurated this work with the enactment by the national legislature of the Land Grant Bill of Senator Morrill, although at the time the nation was engaged in a struggle for life and the civil war was in its most uncertain stage. The several States, following this initiative of the general government, have since assumed their duty, usually in a liberal and enterprising and patriotic spirit, sometimes with apparent reluctance and occasionally evading it largely. In this matter the Western States have been usually more statesmanlike than the Eastern, and fine buildings and noble institutions of learning have marked their progress. In the older States there are larger numbers of colleges already established, often long established and firmly founded by private grants and individual generosity, and there has been less apparent necessity of action by the State, although the essential difference between higher education for the average citizen and that desired by the man of leisure or a member of a so-called "learned" profession is coming to be seen and provided for even among the most conservative of the older colleges.

In some States the work of the State is carried on by private contributions, in large part, directed, nevertheless, toward the education of the people for life. It is, however, well understood that the work is essential to the progress of the country, and that, on the whole, it is not safe or wise to leave it to the sporadic and fitful care of private benevolence; the duties of the State should never be intrusted to enterprises which are of necessity usually mendicant and unequal to their work as are the colleges generally. The latter are always poor and always more or less inefficient from that cause and they are always necessarily mendicant, receiving their accessions of income irregularly and commonly least freely when most in need. This work must ultimately be mainly carried on by the State to insure thorough efficiency and most rapid advancement of the industries and of the people. There will always be ample opportunity for private means to flow into this form of investment for special purposes; but the State must make it certain that the forward movement of civilization and the advancement of the nation is not permitted to halt because of any lack of provision for education of the coming captains of industry or any defect in efficiency of the means thereto. Every man of genius, whatever his circumstances, will be assured of the privilege of gaining that essential training and learning which only can make his genius of value to the world. It is the State which must provide these "freaks of nature," as Huxley called them, these Watts and Faradays and Davys, each genius, according to the great man of science, "cheap at an hundred thousand pounds." That nation will go furthest and fare best which produces and utilizes most fully the largest number of these "freaks of nature." Our country has, perhaps, produced most freely and utilized most fully; but the time has come when even the man of genius, whether in science or in industry, must, to make his talent effective, know what the world has acquired of learning, and must be trained usefully and effectively to apply that learning by means of the most perfect of all known apparatus and methods. That nation which fails thus to utilize its men of ability will inevitably fall behind and its people taste of the bitter bread of poverty.

That State which most and best avails itself of the opportunity to establish institutions of higher learning for the promotion, particularly, of the industries, through education for their leading positions of those men of ability, who will invariably seek their opportunities, will find its investment a handsomely paying one. One such man recently saved to the State of New York a million dollars by a single scientific investigation, and every young man leaving the engineering school has his value doubled at the start, and often multiplied many times later, by the training thus provided by the State. The investment is one that pays the State better than any possible purely commercial one can, and the future is far more advantaged than the present and the public at large is profited manyfold by the ability, natural genius trained by scientific method, which is thus gained for its industrial system.

It is not sufficient, however, that the education offered shall be the best possible of its kind; it is essential for its full utilization, that it shall be given by those who are experts, each in his own branch, and, still further, that each of these experts shall be in constant and intimate touch with all the contemporary, and especially the local, industries of the State. Highest efficiency can not be attained and most prosperous conditions reached by the State unless all the industries are closely and helpfully knit together, and unless every individual in each promotes to the best of his ability the work of each and every other. The State college or university has for its particular opportunity and its especial duty this promotion of the mutual helpfulness of the various departments of industry. Its representation at conventions, its provision of valuable information and its keeping the leaders in the industries well informed of the progress of science and of the arts in directions having interest and importance to them; its scientific researches and attempted discoveries, or its revelations of facts and phenomena having importance in the industries; its finding of the right men for special and important places in which peculiar talent and special training are needed; perhaps more than all, its introduction of new arts and industries and new methods of utilization of natural resources: each and all may advance the best interests of the State inconceivably, and all costs become insignificant in comparison with the benefits derived. This has been true in the past; it will be still more impressively true in the future. It is only the State, however, which can properly carry on this great work and do full justice to the people and to the opportunity.

As between the State and the State college, the obligation is mutual; the college, as the creature of the State, owes to the people composing the State its highest and best work, and always primarily in the interests of the mass of the people and the fundamental industries of the State. The State, on the other hand, owes a duty to the college and, through it, to the people, again: this is the maintenance of the college constantly at the highest possible state of efficiency and fruitfulness by providing it with men and material and suitable accommodations of every sort in such manner that no one member of the staff shall find his usefulness decreased by reason of deficient space, equipment, or opportunity to do good work for the State and for the learner.

In meeting these mutual obligations, experience would seem to indicate that it is the State rather than the college which fails of either interest, ambition, earnestness, or conscientious compliance with duty. It is oftenest the State which fails to see the opportunity to promote the best interests of the people and to take advantage of that opportunity.

In the hundred or more engineering schools of the United States are about fifteen thousand students, of whom about fifteen hundred pass out into business each year. The growth of these schools has been 500 per cent in the last generation, although comparatively few of the splendid private contributions to education of these years have been placed here, where most needed. A few large schools send out the greater part of these young engineers; one-third sending out half and more.

A list of one thousand has been prepared for me, tabulated. The average period since "graduation" is about seven years. Of these, so far as reported, one-third are holding positions of independent responsibility; one-eighth are managers and superintendents of works; 10 per cent are teaching in the professional schools, and twice or thrice as many are wanted. Ten per cent are designing engineers, planning the machinery of the workshops, the manufacturing establishments, the railroads, and the fleets of the country. Several are editors; one-fourth are manufacturers; many are presidents and vice-presidents of corporations; others are treasurers, and the balance are distributed throughout the whole system of industries of the country. One-half of these men are not above an average of 25 or 28 years of age, and 95 per cent are not above 35 or 37. Practically all retain their connection with their profession. They commonly realize and fully appreciate their advantages, educationally.

One writes, for example: "The great value of the training given me and especially by the college is brought home to me forcibly many times every day and I prize that training more than all the wealth of the land."

The severe pruning out of men unsuited to the profession has given these professional schools of engineering the reputation of producing the best-trained of all professional men.

More perhaps than in any other profession is it true that the practitioner, to be successful—which means to be in highest degree useful to the State—must possess a peculiar mental and intellectual make-up. He must unite—at least this is coming to be true very generally if not universally—he must unite that strength of character which every leader must possess, with good sense, such as all men commanding the respect of their neighbors must exhibit, with integrity such as no man can advance without, with thorough professional education and training such as is always essential to professional success. It is further true that the intellectual training of the engineer, for example, furnishes as large opportunity and as great capacity for purely intellectual enjoyment as can possibly any ordinary purely "cultural" education. Nevertheless, the preparation of the engineer for greatest fullness of life demands cultural study and an extent of learning far broader and deeper than the solely professional. He, like all other men, must for highest results make himself a liberally educated man and must attain wisdom as well as culture, learning as well as technical knowledge, if he is to meet men on a common and lofty ground. It is not enough that he shall make of himself a most efficient machine; he must make of himself a gentleman and a scholar as well as a professional.

The outlook for the young man going out into business of whatever sort from a course of study which has comprehended the elements of a good, sound, English education, college courses which have given him some familiarity with the contemporary literatures and access to the languages in which the thoughts of the masters in his field are immortalized and the practice of his art is exemplified, and from a technical training, a professional apprenticeship, which has built up for him foundations, firm and stable, upon which to raise the structure of his later professional career: the outlook for such a man, if himself well fitted by talent, character, and experience to profit by his advantages and opportunities, is now more promising than ever before in the history of the world. The tremendous aggregations of industrial enterprises now coming into form can only be handled by men of more than ordinary capacity, wisdom, and experience, and only the complete union of the learning of the schools, the judgment gained by experience, and the intimate knowledge of the business acquired by the practice of the profession or the vocation, all conspiring with perfect union of the science with the art, will hereafter give highest efficiency in positions of responsibility. The army of industry is now organized and must be officered. Its grades are coming to be as distinctly recognized and established as those of the military or the naval organization, and the kind of man needed for each grade is as distinctly defined. Every competent man will gravitate to his place; for the head of the army and the chiefs of staff are eagerly looking for that rare and precious character for each position as vacated by the falling out of the incumbent of the moment by retirement or death.

Of the calls which I have received for such men from the "captains of industry," 45 per cent are for positions worth $750 to $1,000, 15 per cent at $1,200, 20 per cent at $1,500, 15 per cent at $2,000, 5 per cent at $2,500, and in many cases from two to ten men are sought. The needs are greatest in the highest positions and where men capable of carrying large responsibility and having exceptional executive capacity find their place. One man who did not take his diploma for some years after a business call had withdrawn him from his earlier studies is now a vice-president of one of the largest corporations in the United States; another, only about ten years out of college, has become the president of several important corporations aggregating several millions in capital and as a whole extraordinarily profitable, mainly through his ability, good judgment, and business efficiency.

One of the best gages of the value of these men when well suited to their professions is found in the fact that, when these alumni of the engineering college are asked if they desire to change their present positions, they almost invariably reply that they are well satisfied. Asked at what salary a change would be considered, 10 per cent of these giving definite figures proposed $1,000, 30 per cent $1,500, 30 per cent $2,000, 10 per cent $2,500, and 5 per cent in each grade $4,000, $5,000 and $6,000. The ablest men in highest positions usually declined to consider a change of employers or of employment.

The young engineer, just from college, if he has profited by his opportunities usually gets on slowly at first and very rapidly later on. The man who refused $1,500 a year to accept fifty cents a day, where his opportunities were greater for learning his business, now receives—six years out of college—$3,500; the usual figures are $60 to $75 a month when employed rather than taught in the great manufacturing organizations. Salaries a little later range from $1,000 to $3,000 and sometimes $5,000 and $6,000. The average asked by men willing to change their fields of work as reported a year or two ago was about $2,000 for men seven years out of college. One young man dropped out of college to secure an opportunity to become familiar with an important industry, the chance coming unexpectedly. He returned to take his degree, three or four years later, with a contract for four years, at $6,500 a year, in his pocket.

Many become inventors in their chosen fields and accumulate fortunes rapidly. Others enter great enterprises and build up the cotton manufactures of the South; direct the great departments of the electrical industries; revolutionize the methods of production of pig iron; produce a tool-steel capable of multiplying the work of machine tools; invent a steam-engine governor and take in royalties of thousands a month; systematize a gas industry, gaining a fortune while financially benefiting the stockholders and the gas-consuming public; multiply the rate of transmission of intelligence across the ocean, beneath or above its surface; utilize the electrical energies in light and power transmission by new methods; organize new systems and new industrial establishments. All who thus contribute to the welfare of the people are very sure to secure a handsome commission and scores of these men of the new generation are thus helping others while helping themselves. The conduct of the industries of the country is constantly more and more falling into the hands of the systematically trained and technically learned man.

Young men, such as our best professional schools of engineering are now turning out, are greatly needed and the need is recognized by employers. The demand has been for some years past greater than the supply. A generation ago it was next to impossible to induce the average manager of an industrial establishment to admit the college man within his doors. To-day the same class of men is sought by all, and the larger and the more important the interests involved, the more anxious are the officers of the organization to find men trained in the professional school, combining science with practical knowledge, and prepared to face and to solve the tremendous problems now constantly arising. I have a deep file of letters calling for such men; there is practically none unemployed, unless on the sick list. All the professional engineering schools are thus situated. Turning out a thousand or more annually, the whole output is absorbed by the great industries and immediately upon leaving the doors of the college. If suited to the profession, success is assured; otherwise, failure is just as certain.

The prizes to be won, like those in all other professions, are large; there is always room at the top; the earnings at first are usually small in cash, large in valuable experience; opportunities come in increasing

number if the man is the right man for the higher place; more men are needed than can be found to take the higher positions of responsibility and of commensurate compensation. The wise young professional seeks opportunity for profitable experience without much regard to compensation. I have known a man to refuse a good salary and to accept fifty cents a day, where he saw an opportunity to secure practical experience and training such as, in his estimation, was what he most needed. His spirit was that of Agassiz, who, when asked why he refused an important and lucrative business position, is said to have replied: "I cannot afford to give my time to money-making." Both had their rewards, each in his own way, in that form of professional success which was the highest ambition of each. Many young college men are to-day working for the great railroad companies, for the electrical companies, and for industrial enterprises of all kinds, accepting insignificant pecuniary reward for the time, in order that, by securing that special experience and expert knowledge needed to supplement their special education, they may prepare themselves for positions of honor, of responsibility, and of financial value. Here "the last shall be first."

It is of little consequence what line of work the young man enters, provided it be that for which he is individually well fitted by nature and training. In mechanical and electrical engineering, in shipbuilding and in the railway system, in mining or in public works, great opportunities are all the time, and more and more frequently, offering. It matters little what line the man selects, provided he is naturally fitted to do the work, by talent and by inclination, and that he acquires promptly the needed professional training and a later experience. If able and reliable and loyal to his employers, he is far more likely to be promoted faster than is desirable than to remain unrecognized in any important organization. His early years should be devoted to securing professional knowledge and practical experience, efficiency in his business and ability to deal with other men. Opportunity, responsibility, and financial returns will come later, once he reaches the age at which older men holding such positions begin to drop out. If suited to the work he will find his place.

Meantime, the work of the world is falling into the hands of these able, expert, experienced, and efficient men of the new generation in rapidly increasing proportion, and the professionally trained engineer now finds himself wanted wherever learning, ability, and experience are essential to the success of a great enterprise.

In this great work the student for whom all these sacrifices are made has his part, and his duty is quite as imperative in the utilization of these opportunities as is that of the State to provide them. His first privilege and duty is that of playing his part conscientiously and well. If unable to do the work well that is set before him he should retire to make place for a more competent candidate for opportunity; if found lacking in conscientiousness, he should be retired.

Stradivarius, whose violins to-day will fetch large sums though they cost but little two centuries ago, in answer to a charge that he worked only for pelf, replied:

"Who draws a line and satisfies his soul,
Making it crooked where it should be straight?
An idiot with an oyster shell may draw
His lines along the sand, all wavering,
Fixing no point or pathway to a point.
An idiot one remove may choose his line,
Straggle and be content; but, God be praised,
Antonio Stradivari has an eye
That winces at false work and loves the true,
With hand and arm that play upon the tool,
As willingly as any singing bird
Sets him to sing his morning roundelay,
Because he likes to sing and likes the song."

The spirit of Stradivarius is that which underlies all success, and not only should the protégé of the State illustrate this spirit as justifying his adoption by the State; but he should understand that the interest and pride and ambition of Stradivarius are essentials of his own later advancement. Thoroughness in college work is no less essential and fundamental an element of success with the individual than is the success of the outgoing army of alumni vital to the progress of the country and the growth of the State in all that makes success for the people, or that makes life worth living for the dweller in their midst. Given this spirit of wholesome and cheerful ambition and the atmosphere which it engenders, and the world will be the better and the brighter each day.

Our own progress as a nation depends upon the wisdom and foresight, the patriotism and courage and persistence of our own educators and statesmen and industrial leaders. With wise statesmanship, our own nation may become the leader of the world and our country may always move onward in the van of modern progress. At the moment, what is most needed is the awakening of our legislative and executive officials to the duties and opportunities of the times. It is the fossilized educator and the ignorant and unpatriotic politician, and the demagogue who aspires to lead "labor," and the educated man with his head in the clouds, who are the most serious obstacles to the progress of education, and to that of the nation toward higher and better things. These classes being either enlightened and purified, or extinguished, we may trust the American people to take full advantage of their opportunities and to hold a foremost place in the peaceful rivalry of the nations.

THE RELATION OF SCIENCE TO COMMON LIFE.*

By J. M. MACFARLANE.

MY theme is "The Relation of Science to Common Life," the life of the mass of individuals, of the nation, if you will. A very unacademic subject, you will say, as measured by the older standards. I chose it on that account. In not a few university centers, the time has not long gone when such a subject would have been curtly dismissed with the remark, "We have nothing to do with common life; we follow our own high educational aims." Too often the universities have stood aside in cold and unsympathetic isolation—shall I not also say in helpless disfavor—while the busy thinking world outside has carried forward the beacon lights of truth and progress. Listen to Whewell when, as master of Trinity College (Cambridge), he went up to London fifty years ago to deliver his notable address before the Royal Institution. Speaking on "The Influence of the History of Science Upon Intellectual Education," he said: "I venture to address you, relying upon an indulgence which I have more than once experienced. Of such indulgence I strongly feel the need, on various accounts, but especially that, being so unfrequently in this metropolis, I do not know what trains of thought are passing in the minds of the greater part of my audience who live in the midst of a stimulation produced by the lively interchange of opinion and discussion on the prominent questions of the day." Uttered soon after the exhibition of 1851, and when the scientific world was entering on new conquests, such an apology may seem unaccountable. Happily, our university presidents of to-day are more in touch with the throbbing, vibrating life of humanity, even though they may not claim the profundity of thought that lived in the master of Trinity.

If there be one characteristic more than another of our age and day, it is the steady welding and co-operative development proceeding among the leading races of the world. Nowhere is this seen on so phenomenal a scale as in our country, where with the Anglo-Celt, Jew and Greek, Frank and German, Italian and Norseman together ply the arts of peace. And why such a commingling of human lives? The answer may be given, and so far well, that here liberty is assured to all, that equal rights and equal opportunities come to all. Back of this, however, is the basic fact that in this country scientific progress has been comparatively unhampered by costly patent laws, by hereditary vested rights, by lands being held in the hands of a few. But perhaps above all, and permeating all, though often silently working, there exists a keen and rapid method of inductive reasoning that carries forward the individual and the community on progressive and yet safe lines. It is this method, applied to all branches of science with increasing exactness, as human freedom increasingly asserted itself during the bygone century, which has culminated in the marvelous scientific position occupied by the country to-day.

What relation then has science, and should it have, to our universities on the one hand, and to common life—to the mass of free, earnest thinking people—on the other? In attempting to answer we must constantly keep in view tradition and history—our relation to our ancestors, real or imaginary. We all, like the Chinese, worship these ancestors—at least in their relations—and they worship them most powerfully who are furthest removed from the land that gave them birth. So it is that we fear to break with the past, and inherit incongruous combinations. Says Whewell: "You will not be surprised to be told that our modern education has derived something from the ancient Greek education, because you know that our modern science has derived much from the ancient Greek science. You know that our science—in the ordinary sense of the term—has derived little from the ancient Romans. . . . But if we take the term science in a somewhat 'wide' acceptation, we shall derive from the Roman history not a negative but a positive exemplification of our proposition. For in that wider sense there is a science of which Rome was the mother, as Greece was of geometry and mathematics. The term science may be extended so widely as to allow us to speak of the science of law—meaning the doctrine of rights and obligations, in its most definite and yet most comprehensive form; in short the science of jurisprudence. . . . And thus two of the great elements of a thorough intellectual culture—mathematics and jurisprudence—are an inheritance which we derive from ages long gone by; from the two great nations of antiquity."

So far Whewell, who in attempting to elevate Roman law to the dignity of a science forgot that much of it was unscientific to the last degree, and tended to produce, not organic national equilibrium, but to set the patricians against the plebeians, and both against the bondmen, who often showed finer qualities than either. Little wonder is it that Rome fell, unsaved by her laws.

Let us see whether a different viewpoint and source of origin for the science of law and equally for all scientific relations might not be obtained. Huxley thus puts it: "It is a very plain and elementary truth that the life, the fortune, and the happiness of every one of us and, more or less, of those who are connected with us, do depend upon our knowing something of the rules of a game infinitely more difficult and complicated than chess. It is a game which has been played for untold ages, every man and woman of us being one of the two players in a game of his or her own. The chess board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of nature. . . . Education is learning the rules of this mighty game. In other words, education is the instruction of the intellect in the laws of nature, under which name I include not merely things and their forces, but men and their ways; and the fashioning of the affections and of the will into an earnest and loving desire to move in harmony with those laws. . . . The object of what we commonly call education—that education in which man intervenes and which I shall distinguish as artificial education—is to make good defects in nature's methods, to prepare the child to receive nature's education. . . . In short, all artificial education ought to be an anticipation of natural education. And a liberal education is an artificial education which has not only prepared a man to escape the great evils of disobedience to natural laws, but has trained him to appreciate and to seize upon the rewards which nature scatters with as free a hand as her penalties." To pursue Huxley's reasoning to its ultimate limit, advanced teaching in all the laws of nature is the highest function of the university in relation to our common life. In other words, to make each man who leaves its portals most highly qualified for useful, intellectual, manly life. But, as I hope to show later, this qualification is to enable him to use wisely—not meanly—the forces around him, so as to build society into an organism.

Therefore, every upright pursuit in life which man enters on should have the highest principles and practice governing it represented and taught in our universities, by the best men in the most perfectly equipped manner. This may be an ideal at present. Granted, it is nevertheless one toward which, I am persuaded, every university must move. In this manner science will confer the dignity that is deserved on the physician's scalpel, the bricklayer's trowel, the chemist's test-tube, the engineer's lathe, the biologist's microscope, the agriculturist's spade or plowshare.

It is a property of most scientific questions that they project themselves into the future. Whether we accept the teachings of Kidd's suggestive couple of volumes or not, his prophetic outlook into the future is inspiring, and despite destructive criticisms his principle of "projected efficiency" is one that every true scientist tacitly believes in and works up to.

While it will gladly be conceded that few if any countries foster scientific advance more than America, it will as readily be conceded that this has been mainly on the applied side, and that much remains for accomplishment in non-remunerative educational equipment. Here I place in front rank the need for spacious and splendidly furnished museums for all the sciences. Those of us who have walked, time and again, through the mechanical, the chemical, the zoological, the mineralogical, and other sections of the South Kensington Museum, or corresponding ones of the Continent—not to speak of many local museums of lesser repute—know that we have nothing to compare with them. Suppose we make observations for a time in the mechanical section, where accurate models may be even seen at work. There the schoolboy lingers inquiringly before them, and he thus forms great conceptions of man's inventive relation to the world forces around him. The factory worker learns how his machines have grown, have been evolved, and how he may possibly perfect them further. For the college and university teacher these collections furnish comparative and concrete illustrations by which a lasting picture is fixed in the mind. Such institutions are costly to erect, to furnish, to man, and to support annually. Their high educational worth must be gaged not by the fruits of years, but of decades and centuries, for the mental stimulus they afford is often hidden away and silent. The question of cost should be a minor consideration in planning such undertakings, amid the corporate and individual wealth that characterizes such centers as our own. Civic pride and loyalty, material pride and loyalty, pride in and loyalty to our highest human development should be sufficient impelling force. Here let me say, with all caution and reserve, but yet with perfect conviction of purpose, that when we read or learn of lavish individual expenditures, for individual gratification alone, it should arouse in every one of us the desire to so mold public opinion that such superfluous ostentations shall cease. If the owner of the wealth thus diverted can be shown that his wealth can most patriotically be expended in building up the country's institutions, then we have successfully done battle for the right.

A note of warning is sounded against the dangers of specialization. I trust that every one directly or indirectly connected with our institutions realizes its dangers. Though Darwin pathetically confessed as to its effects, no one has put it more forcefully than Stuart Mill, who says: "The increasing specialization of all employments; the division of mankind into innumerable small fractions, each engrossed by an extremely minute fragment of the business of society, is not without inconveniences, as well moral as intellectual, which if they could not be remedied, would be a serious abatement from the benefits of advanced civilization. The interests of the whole—the bearings of things on the ends of the social union—are less and less present to the minds of men who have so contracted a sphere of activity. . . . This lowering effect of the extreme division of labor tells most of all on those who are set up as the lights and teachers of the rest. A man's mind is as fatally narrowed and his feelings toward the great ends of humanity as miserably stunted, by giving all his thoughts to the classification of a few insects, or the resolution of a few equations, as to sharpening the points or putting on the heads of pins. The 'dispersive specialty' of the present race of scientific men, who, unlike their predecessors, have a positive aversion to enlarged views, and seldom either know or care for any of the interests of mankind beyond the narrow limits of their pursuits, is dwelt on by M. Comte as one of the great and growing evils of the time, and the one which most retards moral and intellectual regeneration. . . . He demands a moral and intellectual authority charged with the duty of guiding men's opinions and enlightening and warning their consciences; a spiritual power whose judgments on all matters of high moment should deserve and receive the same universal respect and deference which is paid to the united judgment of astronomers in matters astronomical." We must acknowledge to a large degree, the saneness of Mill's position, but if we all cease specializing one day in the seven at least, the spiritual power desiderated will have opportunity to dwell in our midst. The Jewish Sabbath is by no means the worn-out institution that some would have us believe.

Another rock ahead in the channel of progress demands most careful consideration and steady action. Our present-day political and economic systems often foster methods by which science and scientific discovery are degraded or robbed of their true value, while the scientific worker is often defrauded of that reward that should come from sturdy effort of mind and hand. It has truly been said that "crafty men contemn studies, simple men admire them, wise men use them." The founding by Besant of what might be called "the authors' mutual protection society" marked an epoch in the history of English literature. No such organization has yet been evolved to foster and protect scientific discovery. But to put the whole question on a much higher plane than that of mere financial well-being, I venture to say that since science

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stands for accuracy, probity, clear statement of fact, unveiling of error of every kind—whether intentional or unintentional—it can have no sympathy with the deceit and chicanery that are so rampant around us, and that threaten at times even to swamp the high ideals of our universities.

Are the laws of science then, as we ordinarily understand these, to be our sole guide and rule in life? This inquiry causes me to recur to Huxley's picture of life already quoted. Are all the moves on the human chessboard to be dictated only by thoughts of self-interest and self-preservation, or even by thoughts on behalf of our friends and offspring, as Huxley, in the later days, attempted to prove. Some of the "moves" operated repeatedly in the world's past have given us an environmental human outcome, products that we call "strong lives," "strenuous lives," "unscrupulous lives," "useful lives," "instructive lives." But the greatest type, and the one that we almost unconsciously worship is "the beautiful life."

Every organism from amœba to man lives by a process that we may call "organic molecular equilibrium." When the supplies of life energy and food integration exceed the dissipations and disintegration, growth and development proceed. When both are balanced maturity has been attained. When the converse to the first holds true, decay sets in. Applying this fundamental principle to our common human life, the highest human scientific aspiration might be expressed in the aphorism "society an organism." Such a condition society is far from having attained to. But like all organic bodies, if it is rightly to perform its functions, and to perpetuate its like, such it should become. At present, even in its highest expression, it consists of human molecules that often exhibit abundant energy, that undergo permutations and combinations, that show affinities and repulsions, but that lack some form of energy necessary to link them into an organic whole, to give them social equilibrium and stability. Society has been struggling through millennia to become an organism, has been searching for that energy and that source of energy that will give it life equilibrium. At times and in places the result seemed to have been achieved, only again to be impaired, or lost amid a chaos of discords, by the disrupting agency of one or of a few unscrupulous souls, who have acted like a disorganizing ferment on the organizing mass.

Though unfashionable with many to-day, and not least with the followers of science, the only motive form of human energy that has stood the test, and that is stronger to-day than ever before, is the power, the force of love, of compassion, of sympathy, as communicated by the greatest social lawgiver the world has seen. The early founders of Christianity were charged with it, and for three centuries they shook and finally subdued the Roman empire. We have it in our midst and it lives through all the upheavals consequent on human competition, on commercial war. In our hospitals, in our college settlements, in our church and public beneficences, in our increased regard for human life, we feel the effects of this energy, though we see it not. The social settlements of Owen and others were truly preliminary nineteenth century scientific experiments to test the strength of the law of love, and the amount of this energy needed to vivify and unify the social organism. Like thousands of scientific experiments before and since they partially failed, but their failures and successes have been recorded, so that succeeding experimenters might carry the inquiry to a successful issue.

The fetish of unbridled commercial competition which has too long lorded over us, is in many ways inimical to our highest interests. It can be a helpful servant if kept in subjection, it becomes a harsh tyrant if worshiped as a god. It cannot retain supremacy alongside the gospel of peace and love. If so, the latter suffers or becomes effaced, and mankind becomes the loser.

THE DEMENY BODY CONTOUR-INDICATOR.

M. G. DEMENY, who has for a long time been the superintendent of Prof. Marey's laboratory, exhibited to the Academy of Sciences, in 1888, a set of measuring apparatus designed for obtaining the form of the body by a graphic tracing. His thoracometer, the profile inscriber, and rachigraph have been used in hospitals and large gymnastic establishments, and we have seen some of them in the athletic clubs of America, where this kind of observation is much in vogue. These apparatus give the form of the body by continuous tracings, but have the defect of being difficult to construct and consequently of being expensive. M. Demeny has recently devised a new measuring apparatus which is applicable to all cases, and which for this reason merits the name of "universal conformer." The object of this instrument is to take a mold of a part of the body, and especially of the vertebral column and thorax, the dimensions and form of which are in very direct relation with the health and force of resistance.

The difficulties met with by orthopedic physicians in the mensuration of the vertical column are often due to the length of time required. When the physician has no apparatus, he is often obliged to proceed by points, taking in succession the different projections of the rachis by means of a rule and plumb line. As the subject may move during the operation, the measurement becomes illusory. With the conformer, the measurement is taken at once, and it is by a sort of molding that the conformation of a part of the body is obtained.

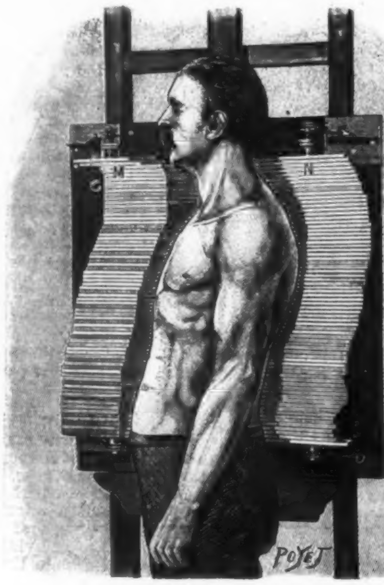


FIG. 1.—THE DEMENY CONFORMER ARRANGED FOR TAKING A SECTION OR VERTICAL PROFILE.

A series of strips of wood, M and N (Fig. 1), are movable around an axis which may be fixed upon a frame or even upon the back of the subject. The ends of these strips are brought into contact with the body and afterward rendered immovable by clamps. The axis is then detached in order that the sinuous contours made by the ends of the strips and representing the form of the body may be taken upon paper. The strips are capable of revolving around their axis and of thus molding themselves upon the sinuosities of the spinal column deflected by curvatures. Two drawings upon two rectangular planes will suffice to preserve a tracing of them in the case of a left curvature.

The instrument permits also of preserving a record of the form of the rachis as accurate as a genuine molding. With this object in view, M. Demeny employs strips of wood covered with a thin layer of dry glue. After making the mensuration, he moistens the strips with warm water, which causes them to stick together and preserve their respective positions, and constitute, after drying, a block exactly representing the contour desired.

With two apparatus held parallel, we obtain the form and vertical section of the trunk or the anterior, posterior, and lateral profiles of the body. For obtaining a horizontal section of the thorax, there are employed four rods provided with strips A, B, C, D (Fig. 2), and so arranged as to form a frame into which the subject to be measured is introduced. The vertical and horizontal conformers may be united upon the same support and permit of taking sections of the body at any height. It is thus easy, with the templets given by the apparatus, to construct true reliefs of the trunk in cardboard, and utilize them for the manufacture of normal or orthopedic corsets, as well as for the cutting of garments. We may note also an interesting application of the instrument, from a medical viewpoint. It permits of finding, immediately and without calculation, a defect in the symmetry of the body, a difference in height between the shoulders and hips, and the pitch of the curvature of the spinal column.

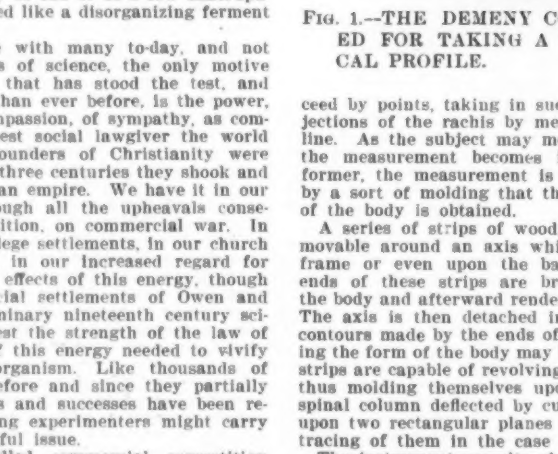


FIG. 2.—THE CONFORMER ARRANGED FOR TAKING A HORIZONTAL SECTION OF THE CHEST.

The apparatus folds together, and, since it presents no projection, may be arranged along a wall without occupying any more space than an artist's easel. —Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

SELF-ELECTRIFICATION OF RADIUM.

QUANTITATIVE measurements of radium rays as so far carried out, have been made only with a view to studying the electrostatic and magnetic deviations so as to determine the velocity of the charges emitted and the ratio of the charge of one particle to the mass of the same. Now as the positive particles discovered by Mr. Rutherford are absorbed to a much more appreciable degree than negative particles, a reservoir permeable to negative particles should take a positive charge in virtue of the positive particles it retains, the magnitude of this charge depending on the radiation emitted and being a measure of the latter. In order to base on this fact a quantitative measuring method for radium radiations, W. Wien (Physikalische Zeitschrift) has undertaken to investigate the self-electrification of radium. In order to obtain an adequate insulation of the radium, the author introduced 4 millimeters of radium bromide into a small platinum crucible, suspended by insulating glass wire. The radium bromide could emit its radiation toward the open side of the crucible, the walls of which on the contrary would retain the radiation. In virtue of the strong absorption, as shown by platinum, it was to be anticipated that both negative and positive rays should be stopped on their way. In the case of equal amounts of both classes of rays being emitted, no electrification of the crucible would take place. If, however, a selective emission in favor of either takes place, one of the electricities must be absorbed because of the radiation through the opening of the crucible. The difficulty met with in the realization of these experiments was the continual diminution in the insulating qualities of the vacuum as produced by the emanation. Radium bromide in fact develops a strongly conductive gas. The author has not been able to complete the development of this gas, even by maintaining radium bromide, previously heated, during six weeks in a vacuum as perfect as possible.

Although the vacuum was as perfect as possible, the most sensitive electrometer used by the author has not detected the least trace of electrification, even when the vacuum was maintained for hours. This negative result could be due to two causes: on one side, this could in fact be a proof of the non-existence of the phenomena anticipated, whereas on the other hand the emanation could still be too strong, imparting to the vacuum too considerable a conductivity. In order, therefore, to make any more accurate measurements, this emanation had to be perfectly eliminated. To this effect the author drew out a thin glass tube until its walls had a thickness of only some tenths of a millimeter; into this tube a platinum wire was sealed. The internal wall of the tube was, moreover, covered with aluminium foil touching the platinum wire. After introducing the radium bromide the tube was closed by sealing. Any electricity accumulated should then issue from the tube by passing through the platinum wire. The glass tube was suspended by similar glass wire, and introduced into the tube. As the small internal glass tube insured an air-tight closing, no emanation could get out of it and deteriorate the vacuum. By this means the author has been able to state electric effects in very satisfactory accord with those anticipated by theory. From these researches it follows that there is no possibility of determining the masses carried by the radiation by weighing, whereas the energy of the latter is by no means negligible. Apart from alterations in the mass, as produced by variations in the velocity, this energy as calculated by the author is 8.7 ergs per second for negative particles and 60 ergs in the case of positive particles.—A. G.

SYNTHETIC ALCOHOL.

SOME very curious, semi-industrial experiments were recently made at Puteaux in the experimental laboratory of the Compagnie Urbaine d'Eclairage par le Gaz Acetylene, in the presence of its stockholders and a few favored persons, and the object of which was to demonstrate the possibility of manufacturing alcohol by starting with the elements carbon, hydrogen, and oxygen.

The problem seems to us to have been admirably solved, although there were presented to us only the problems of Berthelot, the inventor and father of organic synthesis, the modern improvers of whose theory, however, have profited by all the discoveries of science since 1855, and particularly those of the electric furnace, electrolysis, etc.; in a word, by all those innovations which, since 1881, have received the names of volts, amperes, watts, ohms, etc., and thus given a blow to that old grammar which forbade us to burden the proper names of great men with an S. But progress is making!

Despite this blow given to Noël and Chapsal, we must state that the progress made is indisputable. A new carbide (?), which is presented to us as *ethylogen*, undeniably possesses the property of disengaging ethylene gas, that is to say, the synthetic nucleus of alcohol, instead of acetylene gas, when it is plunged into water. Since this carbide is decomposed by water, at the works of production itself, in gasometers identical with those employed for the production of acetylene, there is nothing to prevent the residuum from being used anew, with the addition of carbon naturally, for indefinitely reproducing the same ethylogen carbide. This, in fact, is what occurs, save some insignificant losses of metallic substances, the final expense of the operation being summed up in the addition of carbon (represented here by coke-breeze), and much electric energy, which may be furnished by waterfalls, or, to use a modern term, "white coal."

The ethylene gas disengaged is received in a gasometer, whence it is pumped and made to bubble

through sulphuric acid contained in a series of leaden vessels. The acid absorbs the ethylene gas in producing ethyl sulphuric ether, better known by the name of sulphorinic acid, which thus becomes the raw material from which may be obtained a host of organic products. Upon distilling it with much water, in fact, we obtain alcohol; upon distilling it with less water, we directly obtain ether; and, in causing air, or, more accurately, its oxygen, to intervene, we obtain acetic acid, acetone, and even other carburets.

In the case of alcohol and ether, the true crude materials are the coke of the carbide and the water added to the sulphuric acid, since the metallic salts and the acid (after concentration) may, so to speak, be used indefinitely. In the case of acetic acid and acetone, the air furnishes its complement of oxygen. But we cannot becomingly reckon the air and water in the net cost. There remains, therefore, the carbon, say in practice 440 pounds of coke-breeze, and here is the important point—electric energy obtained cheaply.

For the sake of completeness, let us add that by similar processes, now nearly perfected, it is possible to fix the nitrogen of the air in order to make of it a fertilizer richer and cheaper than the nitrates of Chili. This information may interest our numerous readers who are occupied with agriculture.

All this together constitutes the entrance of chemical synthesis into the domain of industrial practice. It is a complete evolution of chemical industry.

As regards automobilism more particularly, and motors in general, the question of synthetic alcohol of a low price and of carburets very rich in heat units, produced by such processes, is a true safeguard against the gasoline famine that has threatened us for a long time, as well as against the exaggerated rise in agricultural alcohol.—Translated for the Scientific American Supplement from La France Automobile.

A LECTURE-ROOM THERMOMETER.*

A neat and easily made metallic thermometer was recently illustrated in the Scientific American. It was operated by the difference of expansion of two metals. These metals were riveted to each other. Soldering gives better results, because riveted slips are apt to change their rate of expansion. This of course changes the scale of the instrument, which must then be again calibrated.

By using the difference of expansion between copper wire and a heavy piece of pine wood, a very striking instrument may be constructed, which will be found particularly useful in demonstrations on the lecture-room table. When carefully made and once calibrated, it will keep surprisingly close to a standard thermometer through a series of years. An instrument of this kind is peculiarly interesting in following the smaller changes of temperature, like those occasioned by a cloud crossing the sun or the opening or closing of a window. By proper proportioning, the Fahrenheit degree may be made to cover any required space. The copper being used in the form of wire readily takes up or parts with heat. This permits the making of an instrument extremely sensitive to minute and sudden changes of temperature.

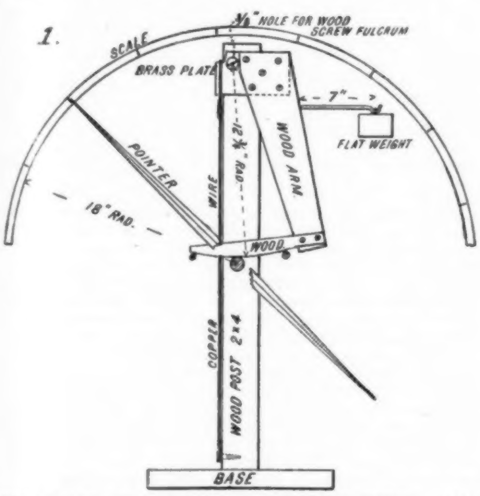
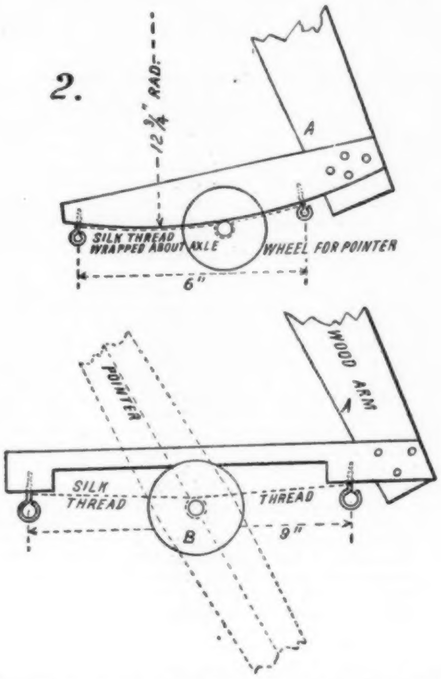


DIAGRAM SHOWING CONSTRUCTION AND DIMENSIONS.

The first engraving is a front view made from a photograph of a thermometer of this kind. It shows the instrument partly completed. Part of the dial is omitted, in order to show some details of construction.

The instrument mechanically measures the length of a copper wire, indicating this length by a pointer on a dial. The copper wire is firmly held at one end, while the other is connected to the main multiplying lever. The lower end of this lever actuates the hand by a thread fastened to the axis. In the instrument illustrated, the wire is 38½ inches long between the points of attachment. After the loops are made it is stretched until perfectly straight. If the wire is bent or has crooks in it, the instrument will not work, at least not properly, as the expansion or contraction is taken up by the elasticity of the bends, and little or no motion is transmitted to the lever.

The short arm of the lever, to which the wire is attached in the instrument illustrated, is ¾ of an inch. The long arm is 12¾ inches to the point where it is connected by a silk thread to the axle which carries the hand. The axle or drum is 3-16 of an inch in diameter, and the hand is 19 inches in length. Working out these dimensions, we have a multiplication of motion of 3,386 times. As copper expands between 32 deg. and 212 deg. F. 0.00000955 part of its own length per degree, and as pine is said to expand 0.00000020 per degree, we may assume that the wood does not practically change its length. As a matter of fact, in practice the wood does not seem to be affected by ordinary changes of temperature to which



METHODS OF CONNECTING FIRST LEVER WITH THE AXLE OF THE POINTER.

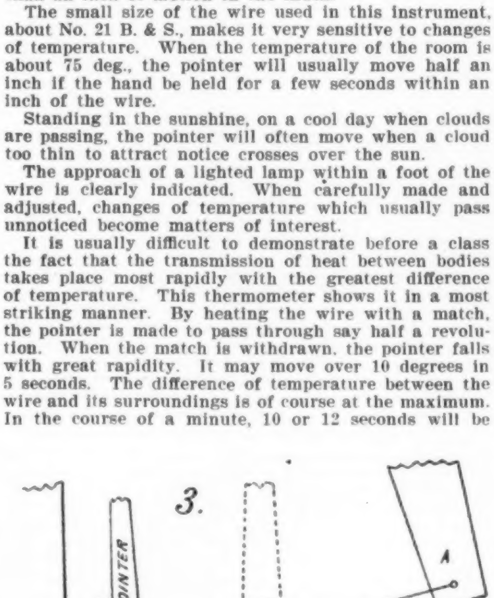
the thermometer has been exposed. The expansion of the copper per degree multiplied by its length, 38½ inches, and again by the number of times the motion is multiplied, gives 1.246, the distance in inches which the hand must move for each degree. This has been found to agree very closely with the actual movement. The remarkable multiplication of motion, more than three thousand times, makes it necessary to have a very stiff post to resist bending. Although as mentioned the support is about 2 inches square, it is possible by placing one finger at the top and one at the center to bend the stick sufficiently to produce more than an inch of motion in the index.

The small size of the wire used in this instrument, about No. 21 B. & S., makes it very sensitive to changes of temperature. When the temperature of the room is about 75 deg., the pointer will usually move half an inch if the hand be held for a few seconds within an inch of the wire.

Standing in the sunshine, on a cool day when clouds are passing, the pointer will often move when a cloud too thin to attract notice crosses over the sun.

The approach of a lighted lamp within a foot of the wire is clearly indicated. When carefully made and adjusted, changes of temperature which usually pass unnoticed become matters of interest.

It is usually difficult to demonstrate before a class the fact that the transmission of heat between bodies takes place most rapidly with the greatest difference of temperature. This thermometer shows it in a most striking manner. By heating the wire with a match, the pointer is made to pass through say half a revolution. When the match is withdrawn, the pointer falls with great rapidity. It may move over 10 degrees in 5 seconds. The difference of temperature between the wire and its surroundings is of course at the maximum. In the course of a minute, 10 or 12 seconds will be



SECTION THROUGH POINTER. CONNECTION OF LEVER AND POINTER. METHOD OF MAKING THE POINTER.

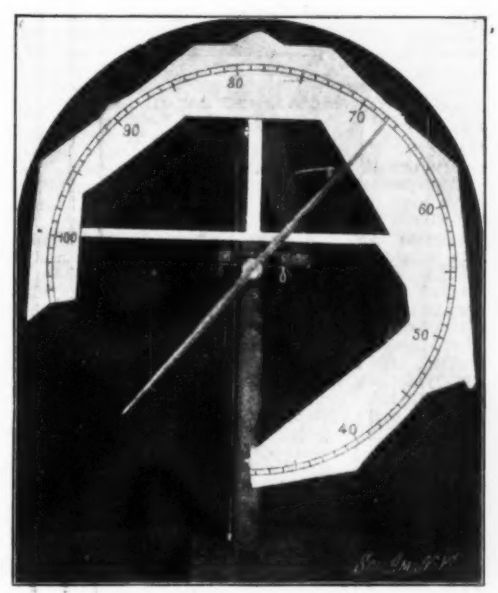
taken in falling 10 degrees. A few minutes later, when the temperature of wire and room are nearly equal, several minutes will be taken for the same fall of temperature. The scale is so large that the demonstration may be observed by a large class without difficulty. It is in fact almost spectacular. Touching the flame of a match to the wire will cause the pointer to swing almost instantly through many degrees. Continuing the heat, a half revolution can be accomplished before the match goes out. The hand will move a degree or more when a lighted match is brought within three or four inches of the wire.

Although the instrument is very simple, there are some details of construction which have been found to increase both delicacy and accuracy of operation. The multiplication of motion in the instrument shown in the engraving and described above (3386 +) is not easily managed until some experience is gained, and in the detailed sketches dimensions are given which reduce this to 2,448 times. This is sufficient to show radiation from a person's hand when held close about the wire. A longer wire will give more motion without increasing the leverage. This is the more practical method of obtaining a large traverse of the pointer for each degree.

Fig. 1 shows the general construction and dimensions. The wire is 43 inches long instead of 38½, as in the machine shown in the photograph. This has the convenience of making the degree 1 inch on a radius of 18 inches. The curvature of the circle is so small that the degrees may be laid off as chords, without appreciable error. The post is made at least 2 by 4 inches. Probably yellow pine, since it is the stiffest of our common woods, will be best. White pine or basswood should be 4 inches square if possible.

The lever of brass is 1-16 of an inch thick. Dimensions are not particular, save for leverage; all that is needed is strength and stiffness. To it is attached an arm of wood, to give the necessary length. Wood is preferred to metal, to save weight and avoid expansion. The hole for the round-headed screw which forms the fulcrum should be ⅜ of an inch in diameter. The other holes are for small screws to hold the arm. A round-headed screw is used, in order to get a shoulder for the plate to bear against. A washer or ring of wire inside prevents the plate from touching the wood. The large size of the wood screw (⅜ of an inch) is necessary to obtain a sufficient hold upon the wood to resist the enormous leverage. If one has access to a lathe, the head of the screw should be faced off and the shank made true and smooth.

The wood arm carries a weight of several ounces



LARGE METALLIC THERMOMETER FOR THE LECTURE ROOM.

at a distance 8 or 10 inches from the main fulcrum. The weight must be made heavy enough to keep the wire straight, its function being to follow up the expansion of the wire.

The pointer or index is best carried by a flat wheel, *B*, Fig. 3, in the center of which is the hub on which is the silk thread to connect it with the long arm, *A*. The edge of the wheel, *B*, has a groove for a thread which supports a weight. (See Fig. 3, right-hand sketch.) When the temperature is rising, the weight moves the hand. The hub has a hole large enough to permit it to turn easily on a needle, which is driven into the post for a fulcrum. This is the simplest and easiest mode of construction. The index hand is not quite as steady and possibly not as sensitive as with the other methods of connection. The needle should be at the center of the post, 12¾ inches from the main fulcrum.

Two better, but more difficult, forms of construction are shown in Fig. 2. In the lower one two screw eyes are carried by an extension from the arm, *A*. To these a thread is carried which is wrapped about the axis of *B*. As the eyes are 9 or 10 inches apart, the geometrical imperfection of the arrangement is not seriously felt. The thread is in two parts and wraps several times about the axis. One end is secured to the wheel, *B*, and the other, inner, end to the axle. This gives a very steady connection. As the end of the arm, *A*, does not move more than ¾ of an inch between the temperatures of zero and 110 deg., the irregularities produced by the unequal lengths of the chords are taken up by the elasticity of the thread itself.

The upper view in Fig. 2 shows a more difficult construction. A sector of a circle is used to hold the thread in position, so that no more is wrapped upon the pivot than is taken from it. The construction is the equivalent of a gear wheel. Fine threads are

* Specially prepared for the Scientific American Supplement.

used, so that there is no side strain on the pivot. Instead of silk thread, the fine chain, such as is used in "fusee" watches, would undoubtedly be better, as it would not be disturbed by moisture in the atmosphere, which at times is sensible with silk. Fusee chain $8\frac{1}{2}$ inches long is quoted in the watchmakers' catalogues at less than 50 cents, so that the expense will not be serious. Any fine, delicate chain will answer. The finest and most flexible wire is too rigid.

In either form of construction the adjustments are made by turning the screw eyes, and so winding up the threads, or chains, and bringing the pointer to correspond with a standard instrument.

A perfectly balanced hand or pointer is essential, and in order to remain balanced in all positions it must be symmetrical. A stiff and strong pointer may be made by using two rolls of paper like gigantic lamp lighters. Properly glued, such hands are light and strong as compared with metal. But they are not as light as is desirable. A pair of them 18 inches long will weigh at least 100 grains. A triangular paper hand, as shown at *D*, Fig. 3, can be made which will not weigh more than 40 grains. The hand shown in the photograph is 38 inches long and weighs 53 grains, yet for two inches at the center there are three thicknesses of paper. It is amply strong, and its lightness is necessary. Such a pointer is best made by folding a strip of stiff, well-sized paper of sufficient length, as shown in the lower part of Fig. 3, or two strips may be pasted together at the center. The pointer is then cut from the edge of the fold as shown. It is opened, and the strips, *E*, at the center, turned in and glued to a strip by which the whole is tacked or fastened to the wheel, *B*.

In making an instrument of this kind, the longer the first lever the better. The weight to stretch the wire and move the parts when the wire expands should be placed near the first fulcrum.

While this is by no means a precision instrument, when carefully constructed it will give indications surprisingly close to those of standard instruments. For the lecture-room table and for the study of minute temperature changes it is really unrivaled.

Its construction and adjustment, and perhaps calibration, are instructive and interesting tasks for the student. A split tube of tin surrounding the wire for its whole length, and packed with snow or ice, gives the melting point of ice. Pouring boiling water down the same tube will give 212 deg. with sufficient accuracy.

For ordinary cases the scale can be compared with a standard instrument, but care must be taken that both bulb and wire really reach the same temperature.

RECENT DISCOVERIES AT SILCHESTER.

Out of the one hundred acres composing the site of the buried Roman city at Silchester, Hants, between eighty and ninety have already been excavated. This year's operations have been unusually successful, because they have brought to light the public baths of the city. The whole of the foundations have now been laid bare, the area being nearly two hundred feet long and about one hundred feet wide; and although everything down to the floor-line has been destroyed, there still remains enough to show the whole system and its arrangement. The baths are like those discovered at Uriconium, near Shrewsbury, but larger. The courtyard at the entrance, apodyterium, frigidarium, tepidarium, sudatorium, and caldarium, with the hypocausts and remains of the hot-air flues can all be traced. It is evident that during the hundreds of years that these baths were in use, many changes were made in the original design. This is particularly observable in the changes of floor level and in the alterations made in the size and shape of some of the rooms. For instance, in the frigidarium there are remains of a division wall built upon the tiled floor. In this room can be seen the lead pipe through which the water was drained off, while the floor and remains of the walls show the specially durable cement which the Romans generally used for lining receptacles for water or fire. In some places a cement floor is found, in others tile, and in others brick laid in herring-bone fashion. Some excellent specimens of both coarse and fine mosaic work are also visible. At one end of the caldarium was found part of a fallen wall made of brick and flint, showing on the under side the plaster with which all the walls were covered both within and without. This fragment shows clearly the side of a window, which must have been square-headed. In almost every room are visible the pilæ which carried the floors. A number of bone pins, beads, styli, etc., were found, as well as portions of columns of different sizes, parts of a basin which must have been eight feet or so across, and a very good specimen of a Roman altar, unfortunately not inscribed, and a handsome Doric capital. The efforts of the past year have also brought to light a number of sites of small houses. It is hoped that these discoveries will bring more contributions to the excavation fund, which has of late suffered from the deaths of some subscribers and other causes.—Architect and Contract Reporter.

A center-hung two-pole series-wound inclosed type 23-horsepower motor, used for driving a coal cutter in a colliery, working pressure 360 volts. The magnet coils were in series with the armature, one on each pole, and both nearly touched the bottom of the motor casing. On receipt of a telegram stating that the motor had broken down, an inspector was sent to examine it. He found the lower part of one of the magnet coils burnt. The cause of the damage was accumulation of oil and coal dust in the bottom of the casing, whereby the insulation of the lower part of the coil had been destroyed and the wires put into electrical contact with each other, with the casing of the motor, and with "earth," between which and the coil there must have been the full difference of potential, owing to a fault on the cable of opposite polarity. The insulation of the other field coil was also seriously damaged by oil, but had not given way altogether. Some system of draining the casings of inclosed motors ought to be adopted, and proper care should be taken to keep them clean internally.—Mechanical Engineer.

ELECTRICAL NOTES.

To facilitate the manufacture of mantles from artificial silk and the like, T. Terrell treats the impregnated thread with a solution of paraffin in benzene in order to waterproof it, and, after knitting, the fabric, in tubular form, is wound like a flat bandage on to a drum, and the whole is subjected to the action of steam. The tissue thus loses its elasticity, and the tubular form given it upon the drum retains its diameter.

A center-hung two-pole shunt-wound dynamo giving 127 amperes at 110 volts, or 90 amperes at 155 volts, was used alternatively for lighting or charging a battery. While working, the armature was short-circuited by failure of the insulation, and several of the wires were completely burnt through, says the Mechanical Engineer. The dynamo stood close to a door leading into the battery room, and the acid fumes from the battery had destroyed the cotton covering of the conductors. The company had advised the owner of the dynamo to fix self-closing doors between the two rooms, or to take other means of preventing the fumes entering the dynamo room, but without effect; so that the breakdown must be attributed to neglect of proper precautions to cut off an obvious cause of damage. To get at the burnt coils half the conductors had to be taken off, and when this was done the insulating covering of the remaining wires was found to be so corroded that it was necessary to rewind the armature entirely. The owner was asked to contribute to the expense, on the ground that quite half the work was necessitated by the rotten condition of the armature, and not by the breakdown, but he refused to bear any expense.

An electric embankment roller has been employed in consolidating the dam of the Grosbois reservoir on the Bourgogne Canal in France. Steam rollers were not adapted for the purpose because of the difficulty of transporting them to the site and of obtaining fuel for them. On the other hand a water power was easily developed for running a small generator furnishing all the current needed for this roller and also for pumping. The machine had three grooved wheels $3\frac{1}{4}$ feet in diameter, one in front which was used in steering in the usual manner and two in the rear with a single fixed axle. The axle carried a large gear which was driven by a worm on the extension of the armature shaft of an 18-horsepower motor. By means of a resistance box the speed of the roller could be varied between 1 and 4 miles an hour. The current was delivered by a pair of wires on which ran trolleys connected by flexible cables with the roller. Current at 250 volts was used. The roller weighed 7,700 pounds, or about 115 pounds per inch length of the rolls. The compression attained with this machine is reported in the Nouvelles Annales de la Construction as 30 to 35 per cent, which is incomprehensible. The earth was spread in layers a trifle less than 3 inches thick and consolidated by twelve to fifteen passes of the roller.

The London Electrician abstracts an article from Ann. d. Phys. describing experiments of Schmauss, the purpose of which was to investigate the behavior of a jet of water falling through ionized air. Lenard has found that water falling through ordinary, not ionized, air upon a metallic plate communicates positive electricity to the plate and negative electricity to the air. The present author finds that on ionizing the air, this effect is obtained by another. The metal plate receives a negative instead of a positive charge, and only after several minutes does Lenard's effect regain ascendancy. Zeleny has shown that when a stream of ionized air is directed against a conductor, the latter, owing to the greater speed of the negative electrons, acquires a negative charge. In the water jet the conductor is moved against the ionized air, and the effect is the same. Moisture seems to favor the absorption of negative ions. The explanation of the earth's negative charge seems now pretty complete. Wilson has shown that negative ions are more effective as nuclei of condensation than are positive ions. His new experiments, as well as those of the present author, show that drops already formed are capable of transporting negative electricity to the earth. All experiments of this kind are complicated by Lenard's effect, which is probably of an electro-chemical nature.

An interesting experiment is described by M. Ch. Féry in a recent issue of Le Génie Civil. The experiment, which was made to test the accuracy of an optical pyrometer of his devising, consisted in the fractional distillation of brass in the electric furnace. This furnace took 600 amperes at 80 volts, and with it 11 pounds of copper could be boiled off in six minutes. On charging it with brass containing 37 per cent of zinc the temperature rose in half a minute to the boiling point of zinc, which was found to be about 1,100 deg. C. This temperature remained nearly constant for one minute, which sufficed to get rid of all the zinc, and in two minutes more the boiling point of copper was reached, which was found to be 2,100 deg. C. The copper left in the furnace at the end of the experiment contained barely a trace of zinc and was very nearly pure, though a little carbon was mixed with it in the form of graphite.

The pyrometer used in these experiments is of a very interesting type. It has the advantage that no portion of it is exposed to a really high temperature, its indications being dependent on the fact that the total radiation emitted by a "theoretically black" body varies as the fourth power of the absolute temperature. The interior of any furnace into which there is but a small opening acts as a theoretically black body. M. Féry's method of measuring the temperature, therefore, is to receive the radiation, from a small opening into such a furnace, on a thermopile so shielded that the amount of radiation received is independent, within limits of the distance of the couple from the opening. This thermopile is connected to a D'Arsonval galvanometer, and the temperature is estimated from the observed deflection in the usual way. In cases in which it is impossible to have an opening direct into the furnace, M. Féry builds a small muffle into the wall of the furnace and obtains his temperature readings by pointing his instrument at the interior of this muffle.

ENGINEERING NOTES.

Lewis Nixon's 58-foot automobile launch the "Standard," equipped with a new screw, made a record run recently with her high-power gasoline engine. The time of the launch's run was 1 hour and 5 minutes from the Atlantic Highlands pier to the steamer "Monmouth's" North River landing. Considering the retarding tide, the run may be called good.

The possibility of rendering the Rhine navigable by steamships between Strasburg and Basle is again being discussed. In a recently published brochure Herr Rudolf Gelpke, who has made a careful investigation into the conditions, gives it as his opinion that the upper Rhine admits of being made navigable for large boats. A trial voyage, undertaken at the instance and expense of certain colliery and shipping firms at Frankfort, Duisburg, and Ruhrort, with the steamer "Justitia," has, says the Kölnische Zeitung, given practical proof of the correctness of Herr Gelpke's views. It is said to be sixty years since a steamer entered Basle.

The municipal gas works of Widnes, England, producing about 1,500,000 cubic feet per day, sells its product at 32 to 24.3 cents per 1,000 cubic feet, which is claimed to be the cheapest illuminating gas sold anywhere in the world. The gas is maintained at 18 candle-power. It is sold at the lower figure for motive-power purposes. It has a calorific value of 670 B. T. U. At 24.3 cents per 1,000 cubic feet it is claimed to be cheaper than Mond gas at 6 cents per 1,000 cubic feet. With gas, such as is produced at Widnes, selling at 24.3 cents per 1,000 cubic feet, 5.5 brake horse power are developed in a modern gas engine for 2 cents, or 0.36 cent per brake horse power.

Nickel steel, or steel containing about 3.5 per cent of nickel, with an elastic limit of 70,000 pounds, is now required for breech blocks and spindles in United States naval ordnance. It is also supplied for the tubes of 5-inch and 6-inch rapid-fire guns of latest model, the prescribed elastic limit being 65,000 pounds. The tube and jacket of the 16-inch gun, recently completed, were made of nickel steel, since the manufacturers would not otherwise guarantee an elastic limit of 50,000 pounds in the metal. The cost of nickel steel, for the present, acts as a bar to its more extended use. The gain in elastic limit is about 30 per cent over carbon steel.

In a recent United States consular report it is stated that the manufacture of Portland cement from blast-furnace slag and limestone in Germany and Belgium has proved successful, and that negotiations are now being carried on to establish the industry in England. It is claimed that Portland cement can be manufactured more cheaply from slag and limestone than from the materials at present employed; and that, owing to the uniformity in the composition of the slag, the finished product is less liable to variations in composition, and is therefore more trustworthy. Mortar made with slag cement in the proportion of three parts sand with one part cement had a tensile strength of 383 pounds per square inch after seven days' hardening, and a strength of compression of 3,880 pounds per square inch. After twenty-eight days the strengths had increased to 551 pounds and 5,441 pounds respectively.

At the recent convention of the Street Railway Accountants' Association in Saratoga one of the papers presented was on "Car Maintenance Records," by S. C. Stivers, lately auditor of the Jersey City, Hoboken & Paterson Street Railway Company, of Hoboken, N. J. In discussing the paper, Mr. Magilton stated that the system described had not been used to a very great extent as yet, and he asked if any instance could be cited where car wheels or other important parts of the car had been rejected as not up to standard. This work, in his company's case, was done outside of the general office, and he (the speaker) had not a very deep interest in it directly, as yet, although he expected to have later on. His company had from time to time rejected certain purchases, but the records were not yet complete enough to show that they had not been up to standard.

Mr. Pease said that his company's wheels were all guaranteed to make a given number of miles. If the wheels did not make the required mileage, the company did not pay for them. The company was not keeping the car-maintenance record only so far as car wheels are concerned. For that, the facts are ascertained by the use of the usual car-mileage record, with the date when the wheel was put on and taken off, and if it has been reground that date also is entered. When a wheel was removed on account of chipped flange and had not made the required mileage, the company did not take the wheel. It kept a record of each wheel, and not of a few selected ones only. The speaker did not know whether it was necessary to number each wheel, but thought it was advantageous; his company's wheels were all numbered by the car wheel company, no two bearing the same number.

Mr. White reported that his company kept car mileage records, but it did not buy its wheels with any special guarantee, at least did not keep the record for that. If the company did not get the mileage out of the wheels that it expected, it looked about for something better. It never got any rebate on any wheels that did not wear. He inquired if, under the guarantee, there was ever any question made of the purchaser's complaints.

Mr. Pease replied that there never had been in their experience. The cause of removal of the wheel was a determining factor. If a wheel were worn flat from sliding or skidding, was then reground and afterward made the required mileage, the purchasing company paid for the wheel. A record of 40,000 miles with them covered the life of the wheel.

Mr. White pointed out that there was quite a number of things entering into the question of the life of a wheel, some of which, in the way of repairs, he thought, were rather unnecessary.

Mr. Smith wished to know whether Mr. Pease's company could get the same guarantee from the manufacturers on wheels to be used with the air brake as with the hand brake, and he was answered in the affirmative.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Shoes in Bogota.—A boycott was declared recently by the shoemakers of Bogotá refusing to repair in any way shoes of American manufacture, having become alarmed at their cheapness and the hold they are getting on the market here. This suggested to me that a report on the shoe trade of Bogotá would be of interest to our manufacturers.

The shoe trade until now has never been an important one. Shoes have generally been supplied by native workmen, using imported leather, and the little foreign trade which existed was controlled by English and European houses. The United States has, however, lately put upon the market an article so low in price and so good in quality that a continued yearly increase may be expected if this class of shipments is continued.

The shoe trade may be divided into three classes—shoes used by those who consider themselves the fashionable class, by the middle class, and by the poorer class, who wear principally the native-made sandals manufactured from fiber.

The first class use almost exclusively the best Parisian shoe, such as the Clouet and Vignix makes, which have, to this extent, almost undisputed hold of the market, and will probably keep it, as Bogotá society models after Paris in all things concerning style. However, the high-class American shoe is gaining favor.

It may be well to state here that the total sale of the French article is not large, as the price for both sexes is $12 per pair.

The middle class have hitherto been supplied principally by native workmen, and among the native work of this class must be mentioned a Bogotá factory, which is operated entirely by machinery and in conjunction with the principal tanneries near the city. This factory turns out a good class of work and gives promise of doing a profitable business.

Now, however, American manufacturers are supplying the town, not because they have a more attractive article than European or English houses (on the contrary, the American shapes and styles have only recently found favor, while the foreign manufacturers, in marked contrast to the American manufacturers, imitate the native styles), but solely because the United States seized the opportune moment when the introduction of a moderately priced foreign article became imperatively necessary.

On the outbreak of the war, foreign exchange rose and rendered it impossible for imported goods, paid for in gold, to compete with native-made articles. Then came scarcity and an unprecedented rise in native prices, quite out of proportion to the depreciation in paper money, and the market was again open to foreign goods. This has especially affected the shoe trade, for articles of clothing are a necessity; but, with a few unimportant exceptions, shoes are the only article of clothing for which the public have not been entirely dependent on imports.

This was the opportune moment, and when prices had reached such a point that the local tradesmen refused to work for less than $5 or $6 a pair, the market was suddenly supplied with American shoes selling for from $4 to $6.

American styles are certainly different from the French, but American goods have been forced on the market and Bogotáns are gradually coming round to a liking for the American style. It will therefore be their own fault if American manufacturers lose the market so recently gained, for they can put an article in the Bogotá market so cheap that European manufacturers will not care to compete therewith. I have seen shoes selling here for $6 a pair which cost in the United States about $1.50 wholesale per pair. Some one is therefore making an excessive profit, and the price at which the article could be sold here, making the minimum of profit, substantiates the statement made above and would effectually block all competition.

In a conversation a few days ago an English merchant was heard to say, "America has completely driven out all competition in the shoe market here, and it will only be her own fault if she ever surrenders the market again, as under normal conditions it is impossible for Europe to compete with her," and this about expresses the situation, but I regret to say that from present indications our merchants are pursuing the very course to lose it, and lose it quickly.

If our merchants and manufacturers would confine themselves to shipping a good, medium quality of shoe, thereby cultivating the market and giving some thought to their customers—in other words, finding out the desires and wants of the people, and not trusting to statements of merchants here—their standing on the market would become so firm that there would be no chance of their losing it, for there can be no doubt of the growing popularity of American shoes.

On the other hand, instead of improving their favorable hold on the market by shipping the class of shoes referred to, the merchants here have imported very recently a class of rubbish and cheap stuff, the manufacturers congratulating themselves, likely, at having gotten rid of the goods and the merchants here at having made their profits, neither giving thought to the injury that will result in future therefrom in this profitable market.

While the people in their present mood take them eagerly, being American shoes, unfavorable comment has already arisen, and one result has been the boycott mentioned at the beginning of this article.

The continuation by American shoemen of the policy just cited can but result in the return of this trade to the English and other European manufacturers, to whom, under ordinary circumstances, it ought never to return, and the loss to the United States of a profitable market in the future.

While there is a tenfold increase on both shoes and leathers in the new tariff, the relative position of the importer and native maker remains the same. The Bogotá workmen use, in all cases, native-made leather for soling and heeling, but this gives them no advantage in competing with the ready-made imported article. With the present conditions the workman has to pay a considerably higher price for native-made leather, which is of very poor quality, than would have to be paid in the United States for a much superior article.—Alban G. Snyder, Consul-General at Bogotá, Colombia.

Opportunity for American Enterprise in Madrid.—The prospective building of the Gran Via, the great boulevard that is to run from the Puerta del Sol through the crowded quarter of Madrid to the new part of the city, offers a splendid opportunity for American capitalists to invest with profitable results. From a conference with the projector of the Gran Via and the civil governor of Madrid, I am able to communicate to the department an outline of this great work, in the hope that it will find means to bring the matter to public notice in the United States. Let me then briefly outline the reasons for this undertaking, which are: (1) the terribly crowded condition of the old quarter, the great disease breeder of the city, and the consequent desire of the municipality to direct popular habitation to the open fields in the suburbs, and (2) the vast army of unemployed that is constantly streaming into Madrid, offering even now a serious problem to the government. To facilitate easy communication between the Puerta del Sol and the new part of the town and the squares thereabout, to reach which takes a considerable time, and to improve the sanitary condition of the city, the government accepted the plans of Architect Señor José L. Sallaberry, and will now build the Gran Via; but as everything of a public character in Spain is done by private contract, the government has subsidized the project in the following manner:

1. It grants eignt years to the contractors in which to complete the work, and provides no penalty if not finished within the specified time.

2. It sells to the contractors all the properties, inclusive of buildings, along the line of the projected boulevard at the present rate of depreciated values, for which the properties have already been condemned.

3. It exempts forever from increased taxation the properties so acquired after the boulevard shall be built.

4. It exempts forever the properties so acquired from the 4 per cent sale and resale tax which must be paid on all real estate sold.

5. It gr[illegible] the contractors exclusively a perpetual franchise [illegible] a street car and electric plant system on the boulevard, which is to be a mile in length and to continue at the pleasure of the contractors.

6. It permits the erection of nine-story buildings on both sides of the boulevard and exempts the owners from taxation on modern improvements.

7. It permits the construction of kiosks along the route without taxation, and benches and chairs, for which the contractors are free to charge a certain price. A similar charge is now exacted on the line of the existing boulevard.

8. It subsidizes the undertaking with 11,000,000 pesetas ($2,123,000), payable, with interest, in four installments.

There is enough building material in the old houses to build one-third of the houses on both sides of the boulevard. There are immense fields about Madrid where billions of bricks can be made, and both land and labor are very cheap.—Adolphe Danziger, Vice-Consul at Madrid.

French Building Trades Exhibition.—An exhibition of arts connected with the building trades will open at the Grand Palais, Champs Elysées, on July 30. The exhibits will be divided into six groups, and each of these groups is subdivided into classes. The groups are as follows:

I.—Cheap habitations and social economy.
II.—Architecture.
III.—Hygiene and health.
IV.—Building industries.
V.—Civil engineering, public works, and transport.
VI.—House decorations (fixed or movable), furniture, and industries connected therewith.

The chief subjects comprised in the various classes are: Architecture as applied to houses, factories, farms, cycling, and automobiling; cheap furnished lodgings for the working classes; external and internal decorations; heating, lighting, and ventilation; excavations, construction of sewers and drains; building materials; stone, marble, plaster, lime, cement, bricks, pottery, artificial stone, pressed cork, and mosaics; wood; stairs, flooring, and parquetry; iron: verandas, balconies, elevators, locks, etc.; heating: stoves, hot air, and steam; lighting by gas, electricity, alcohol, and acetylene; roofing: tiles, slates, zinc, lead, copper, cement, and tarred paper; plumbing: pipes, siphons, traps, water closets, sinks, baths, etc., for private or public buildings; painting and glazing: lead and zinc paints, varnishes, damp destroyers, glue, enamel paints, paints, window and floor glass, mirrors, frames, and gilding; furniture and decoration and all connected therewith; and machinery and tools for the manufacture of furniture.

The show, it will be seen, bids fair to be extremely interesting. It will remain open till November 15. The office of the Exposition de l'Habitation is at 51 Rue Taitbout, Paris.—John K. Gowdy, Consul-General at Paris.

Industrial Development of Ireland.—European papers are commenting favorably on the industrial outlook in Ireland. The Handels Museum of July 9 says the improved prospect brought about by the land bill recently laid before Parliament by the present government, is increasing the desire of capitalists to invest in Irish industrial enterprises. An English-Irish syndicate has been formed for the purpose of removing one of the worst evils with which Irish industrial development was afflicted, viz., dear coal. The industrial difficulties due to the absence of coal in Ireland are to be removed by the use of turf, in which the island abounds. This is to be cut, dried, and pressed into bricks. A commission of experts was sent recently by the syndicate to Continental Europe for the purpose of studying the methods of manipulating peat, turf, and bog-land fuel. The results were very satisfactory, much more than justifying the expense and effort. The expert evidence resulted in the establishment of a turf-brick mill in the north of Ireland, with a daily capacity of 150 tons. Others are to be erected, as soon as possible, in other parts of the island where turf is found.

Another industry intimately connected with the breaking up of the great Irish estates is the production of spirits and starch from potatoes. Several distinguished persons are participating in this industry, and the company commands many millions of dollars. This company sent experts to the Continent, particularly to Germany. They made a complete study of the methods of production, the machines used, the drying and other apparatus, etc. The Germans are looking for a large market in Ireland for their machinery, but expect that the world's spirit and starch market will be materially affected by the Irish product.

Flour and Wheat in Australia.—The imports of wheat and flour into Australia from January 1 to June 30, 1903, are equivalent to 10,276,349 bushels, or 275,259 tons of wheat. This total consists of 7,399,421 bushels of wheat and 59,936 tons of flour. The following summary shows the quantities (reduced to the equivalent in wheat) received at Melbourne, Sydney, Newcastle, and other places:

From—	Melbourne.	Sydney and Newcastle.	Other places.	Total.
	Bushels.	Bushels.	Bushels.	Bushels.
Pacific coast	2,782,257	3,583,317	480,013	6,845,587
New York	154,601	605,144	288,896	1,048,644
India	103,636	....	7,405	111,040
Argentina	445,274	1,360,344	400,692	2,206,310
London	14,400	70,368	....	84,768
Total	3,500,170	5,619,173	1,157,036	10,276,349

The total to all ports as stated above is equivalent to 275,259 tons of wheat. Adding about 51,750 tons to arrive from the Argentine Republic, and about 5,800 tons to arrive from the Pacific coast, the total quantity already provided for is equivalent to about 332,800 tons, or 12,424,500 bushels.—John P. Bray, Consul-General at Melbourne.

Iron Trust in Austria.—At the close of the year 1902 the iron industry was in a materially changed condition as compared with the year 1901. The attempt made in 1901 to put the home market on a sounder footing had failed, and reckless competition of the disorganized industry depressed values to such a low level that most establishments must have worked at a loss. Since then the position of this industry has undergone a complete change. The bitter struggle of competition led eventually to a renewed coalition of the iron works in Austria, and an iron trust has been formed, to continue for a period of ten years, which, though it may not be free from fault, is considered unique with regard to the completeness of its organization, being based upon much broader lines than the previous iron syndicate.—Ethelbert Watts, Consul, Prague.

French Skilled Workmen for the United States.—The usual number of buyers for the American market at Roubaix during the past year made purchases in amazons, zebelines, voiles, and novelties in wool and wool and silk. Manufacturers seemed desirous of selling, even at small profits, in order to give employment to their workmen, who might otherwise seek other fields of activity. Nearly 2,000 skilled hands have left Roubaix-Tourcoing for the United States during the past year. Many of these are now employed in factories established in the United States by manufacturers from this district.—W. P. Atwell, Consul, Roubaix.

Dunkirk-American Trade.—It is to be regretted that no regular steamship lines exist between Dunkirk and New York. In consequence of the irregular sailing of the boats of the Barber Line many goods are forwarded via Leith and other transshipment ports. I am strongly inclined to believe that there would be a chance for a well-developed Dunkirk-American trade if a steamship line were established with guaranteed regular sailings.—Benjamin Morel, Consular Agent, Dunkirk.

Tariff Classification of Ribbons in Venezuela.—The President of the Republic has decreed that tapes or ribbons of linen, cotton, or wool that have India rubber in their textures must be classified, for tariff purposes, with tapes or ribbons which contain no India rubber.—E. H. Plumacher, Consul, Maracaibo.

Cotton Yarns in Syria.—The German consul at Damascus reports large imports of cotton yarns to Syria. The numbers run from 16 to 24 English. England supplies by far the largest part of the importations.

Index to Advance Sheets of Consular Reports.

Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

TRADE NOTES AND RECIPES.

How to Clean Tarnished Silver.—Silver loses its luster and becomes tarnished after prolonged use. It can be treated by various methods to restore its luster, the choice of the method depending on the appearance presented by the silver. If the articles are only slightly tarnished, the following is the most suitable method: A mixture should be prepared consisting of three parts of best washed and purified chalk and one part of white soap, water being added till a thin paste is formed, which should be rubbed with a dry brush, the rubbing being continued till the articles are quite bright. As a substitute, whiting, mixed with caustic ammonia (spirit of sal-ammoniac) to form a paste may be used. This mixture is very effective in cleaning silver, but is attended with the disadvantage that it has a very unpleasant smell and strongly excites the lachrymal glands.

Leather Waste as a Protector Against Heat.—Portions of leather, such as the fibers of sole leather of any size and form, are first rendered soft. The surface is then carded or the surface fibers scratched or raised in such a manner that when several pieces are pressed together their surface fibers adhere, and a compact, durable piece of leather is produced. The carding can be done by an ordinary batting machine, the action of which is so regulated that not only are the pieces of leather softened, but the fibers on their surfaces raised. The structure of the separate pieces of leather remains essentially unaltered. The raised fibers give the appearance of a furry substance to the leather. The batted pieces of leather are well mixed with paste or some suitable gum, either in or outside of the machine, and are then put into specially shaped troughs, where they are pressed together into layers of the required size and thickness. The separate pieces of leather adhere and are matted together. An agglutinant, if accessible, will contribute materially to the strength and durability of the product. The layers are dried, rolled, and are then ready for use. The pieces need not be packed together promiscuously. If larger portions of waste can be secured, the separate pieces can be arranged one upon another in rows. The larger pieces can also be used for the top and bottom of a leather pad, the middle portion of which consists of smaller pieces.

Method of Preparing Colored Tinfoil.—By pouring tin from a funnel with a very long and narrow mouth on to a linen surface, the latter being tightly stretched, covered with a mixture of chalk and white of egg, and placed in a sloping position, very thin sheets can be produced, weighing not more than 700 to 750 grammes per square meter, and capable of being easily transformed into thin foil. Pure tin should never be used in the preparation of foil intended for packing tobacco, chocolate, etc., but an alloy containing 5 to 40 per cent of lead. Lead has also been recently plated on both sides with tin by the following method: A lead sheet from 16 to 20 millimeters thick is poured on a casting table as long as it is hot, a layer of tin from 4 to 5 millimeters in thickness added, the sheet then turned over and coated on the other side with tin in the same manner. The sheet is then stretched between rollers. Very thin sheet tin can also be made in the same way as sheet lead by cutting up a tin cylinder into spiral sections. Colored tinfoil is prepared by making the foil thoroughly bright by rubbing with purified chalk and cotton, then adding a coat of gelatine, colored as required, and covering the whole finally with a transparent spirit varnish. In place of this somewhat troublesome process, the following much simpler method has lately been introduced: Aniline dyes dissolved in alcohol are applied on the purified foil, and the coat, when dry, covered with a very thin layer of a colorless varnish. This is done by pouring the varnish on the surface and then inclining the latter, so that the varnish may reach every part and flow off.—Der Metallarbeiter.

According to the Werkstatt, to stick pictures to glass, clean the inner hollow side of the glass thoroughly, pour on gelatine dissolved in boiling water, lay the picture on and pour on gelatine again, so that everything swims. Then neatly remove what is superfluous, so that no blisters result, and allow to dry. The following recipe is said to be still better: Gelatine, 16 parts (weight); glycerine, 1 part (weight); water, 32 parts (weight); methylic alcohol, 12 parts (weight). The mixture is prepared by causing the gelatine to swell in water, then dissolving it with the use of moderate heat, adding the glycerine, stirring thoroughly, and pouring the whole in a thin stream into the alcohol.

A Formula for Imitation Vichy Water, based on the analysis of Bauer-Struve, is published in the Druggists Circular and Chemical Gazette:

Vichy (Grande Grille).

Sodium iodide	0.016	gramme
Sodium bromide	0.08	gramme
Sodium phosphate	2.6	grammes
Sodium silicate	80.0	grammes
Potassium sulphate	125.4	grammes
Sodium chloride	139.4	grammes
Sodium carbonate	6,792.7	grammes
Aluminium chloride	1.2	gramme
Strontium chloride	1.5	gramme
Ammonium chloride	3.2	grammes
Magnesium chloride	24.5	grammes
Calcium chloride	170.5	grammes
Manganese sulphate	0.46	gramme
Iron sulphate	1.7	gramme
Sulphuric acid	40.1	grammes
Water to make	10	gallons

Mix the first seven ingredients with about ten times their weight of water and filter. In the same manner, mix the next five ingredients with water and filter; and then the last three ingredients. Pour these solutions into sufficient water contained in a fountain to make ten gallons, and charge at once with carbon dioxide gas.

Waters like the above are more correctly named "imitation" than "artificial" we think, as the acidic and basic radicals may bear different relations to one another in the natural and the other.

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